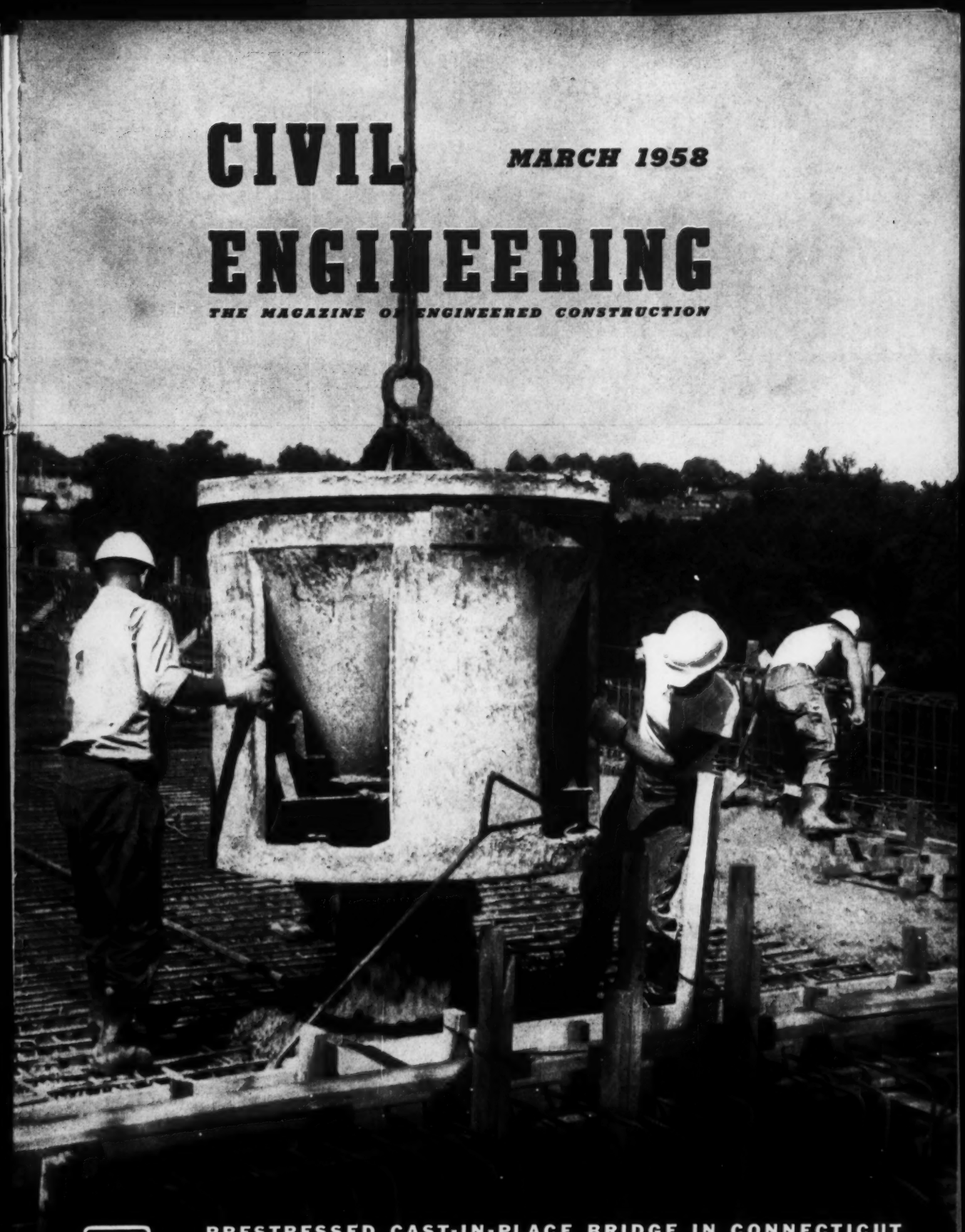
CIVIL ENGINEERING

MARCH 1958

THE MAGAZINE OF ENGINEERED CONSTRUCTION



AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

PRESTRESSED CAST-IN-PLACE BRIDGE IN CONNECTICUT

...See article by Linberg and Schupack

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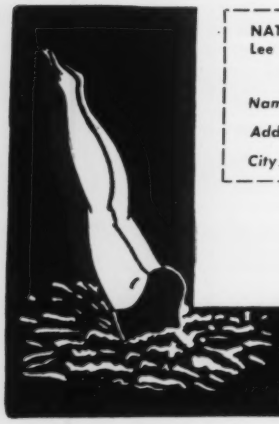
America's Finest Engineered Pool

PRESTRESSED, PRECAST CONCRETE UNITS SAVE LABOR COSTS

NATIONAL prestressed pool packages are available in all sizes from 16 x 32 up to any desired dimension for private and public pools. NATIONAL pools are approved by State Board of Health, and are designed to withstand forces caused by freezing in cold climates.

NATIONAL manufactures a complete line of superior equipment—underwater lights, vacuum cleaners, filters, etc. We retain a highly specialized engineering staff. Services of our staff are available, if desired, to all engineers and architects.



NATIONAL POOL EQUIPMENT CO.
Lee Highway, Florence, Alabama
Please send information on National Prestressed Pools

Name .....

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City ..... *Zone* ..... *State* .....

I am interested in:
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pool equipment co.
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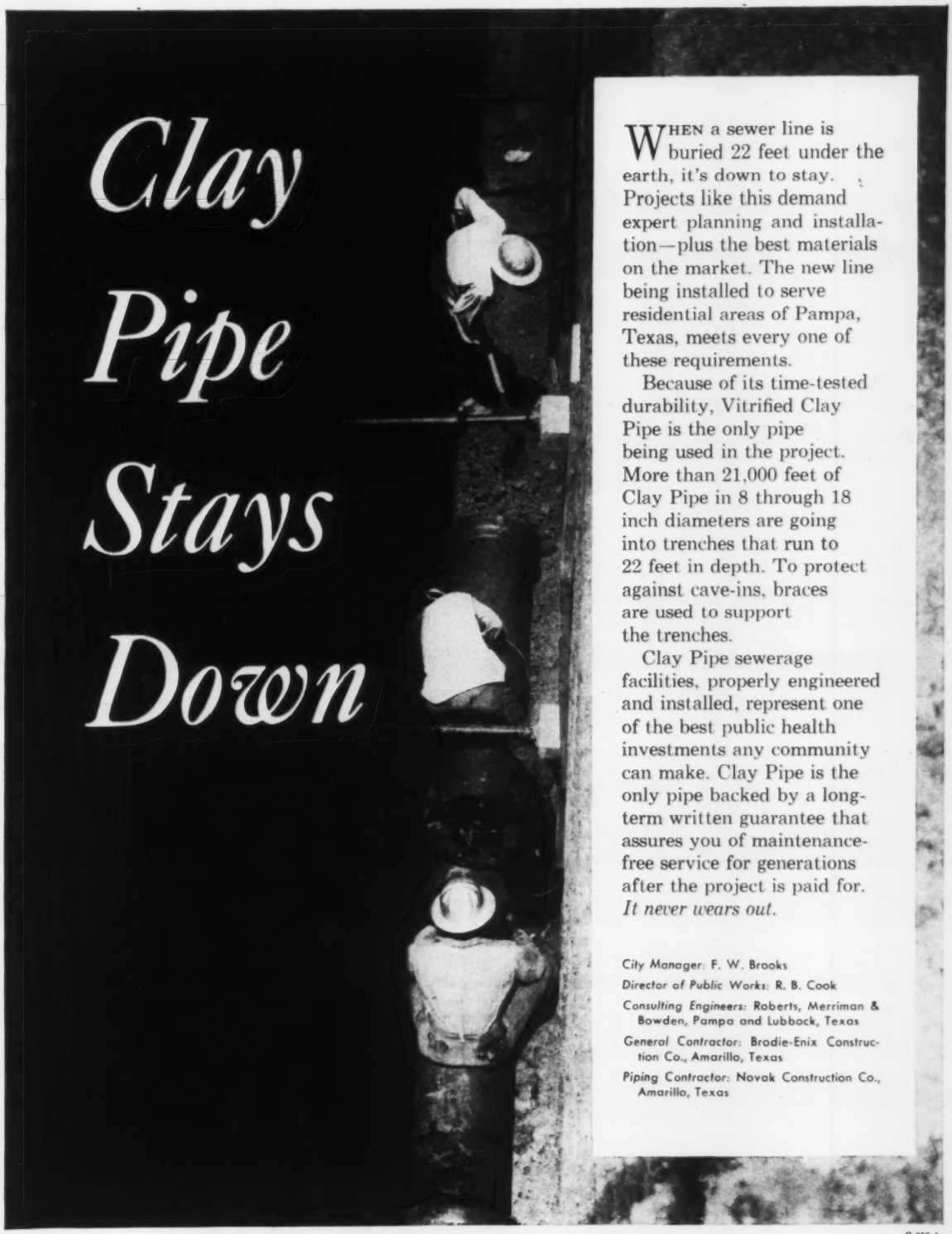
Clay Pipe Stays Down



WHEN a sewer line is buried 22 feet under the earth, it's down to stay. Projects like this demand expert planning and installation—plus the best materials on the market. The new line being installed to serve residential areas of Pampa, Texas, meets every one of these requirements.

Because of its time-tested durability, Vitrified Clay Pipe is the only pipe being used in the project. More than 21,000 feet of Clay Pipe in 8 through 18 inch diameters are going into trenches that run to 22 feet in depth. To protect against cave-ins, braces are used to support the trenches.

Clay Pipe sewerage facilities, properly engineered and installed, represent one of the best public health investments any community can make. Clay Pipe is the only pipe backed by a long-term written guarantee that assures you of maintenance-free service for generations after the project is paid for. *It never wears out.*

City Manager: F. W. Brooks

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Consulting Engineers: Roberts, Merriman & Bowden, Pampa and Lubbock, Texas

General Contractor: Brodie-Enix Construction Co., Amarillo, Texas

Piping Contractor: Novak Construction Co., Amarillo, Texas

C-258-1

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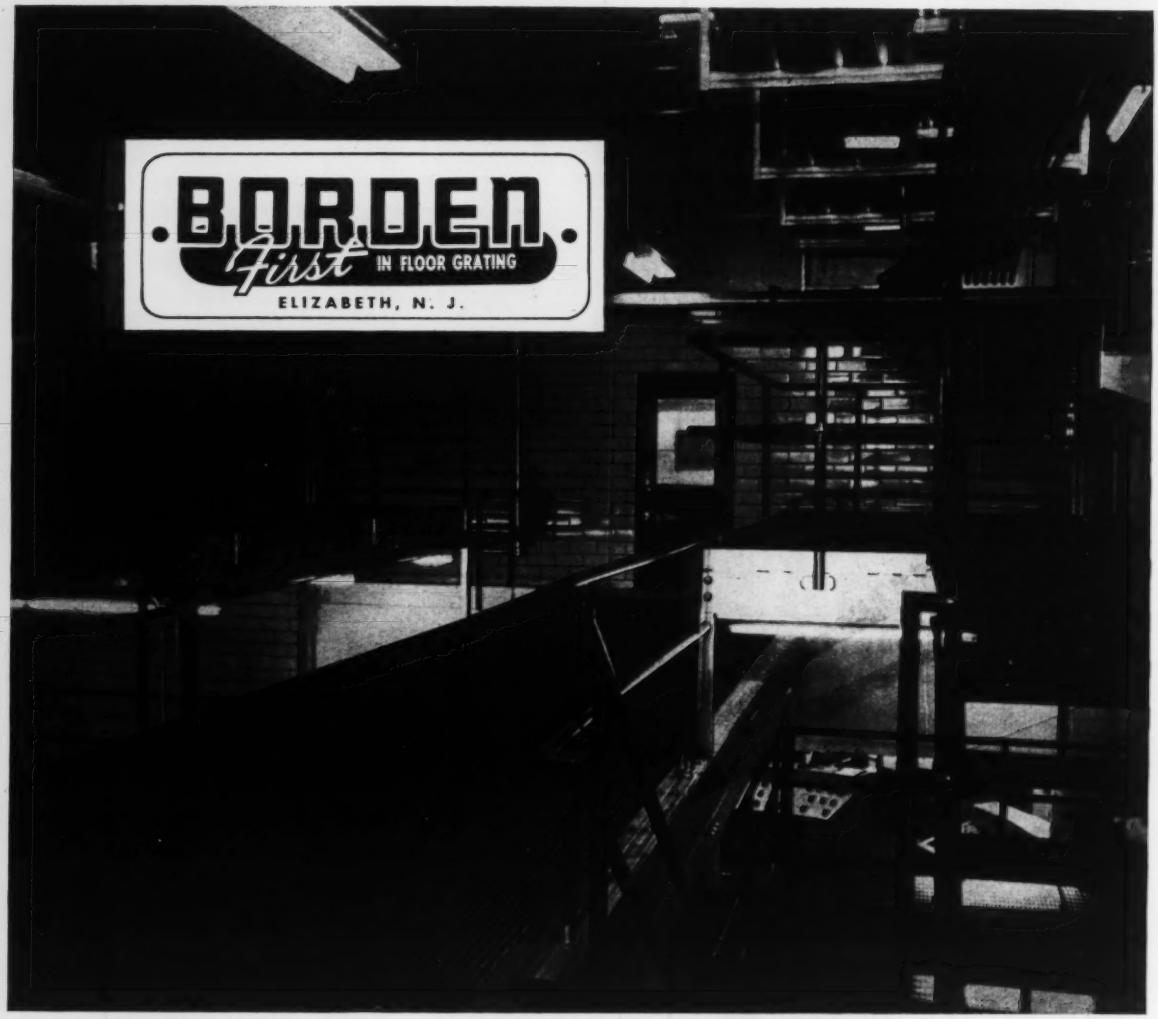

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CIVIL ENGINEERING

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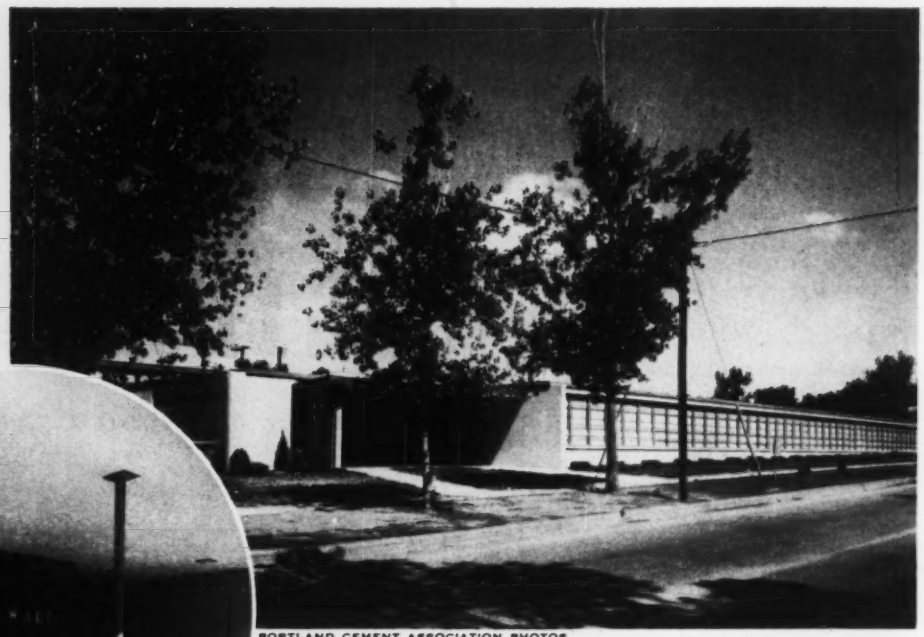

North Ward School

PORTLAND CEMENT ASSOCIATION PHOTOS

For Low Cost Beauty

Architectural Concrete and Concrete Masonry made with Ideal Cement provide a BEST BUY for Schools

An economical dual application of concrete was developed for the construction of the North Ward Elementary School in Superior, Nebraska. On both the inside and outside of this handsome school building, concrete walls were left exposed.

Architectural concrete exterior walls provide an attractive, low-annual-cost exterior treatment for the entire building. On the inside, lightweight concrete masonry walls fulfill a load-bearing as well as a decorative purpose. The interior ceiling was constructed of exposed concrete filler-blocks to provide additional economies when used with the thin concrete roof slab.

This unique school building provides a total of 22,750 sq. ft. of space at a cost of $11.33 per sq. ft.—is an outstanding example of the way architectural concrete and concrete masonry provide beauty, economy, and long life with minimum maintenance. Ideal Cement was used exclusively for all concrete and concrete masonry units in North Ward Elementary School.

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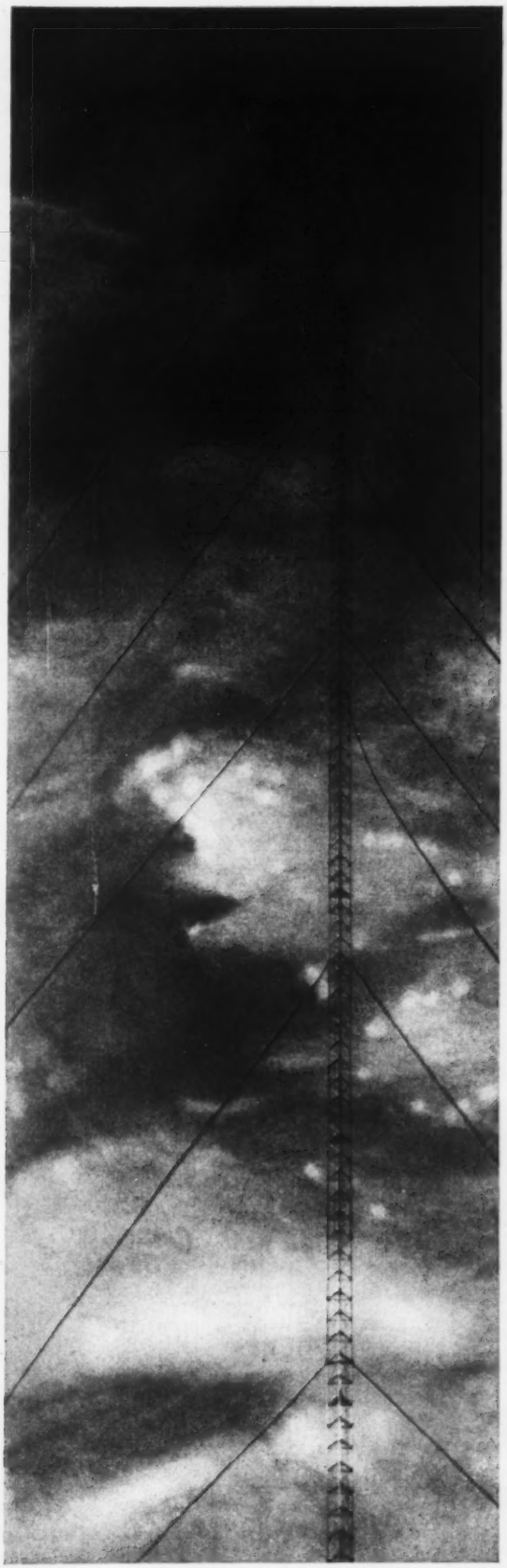
DENVER, COLORADO

15 Plants and 4 Terminals Serving
Some of the Most Rapidly Growing Areas of the Nation



Six Sets of Roebling Guys Keep 1356 Foot TV Tower in (and on) the air

The WTEN-TV transmitting tower in Albany, N. Y. is the second tallest man-made structure east of the Mississippi River, taking second place only to the Empire State Building. Kline Iron & Steel Co. of Columbia, South Carolina, designed, fabricated and erected this "Kimco Tower." Two even taller towers are contemplated at Durham, N. C. and Columbia, S. C. When completed these will be the tallest towers in the East.

This Kimco Tower is held vertical to the earth by approximately 19,305 feet of various sizes of Roebling prestretched galvanized bridge strand. Specifically, the tower is guyed in this manner, starting from the ground up: three 630-ft. strands of 1″ diameter; three 730-ft. strands of 1″ diameter; three 870-ft. strands of 1⅛″ diameter; three 1,230-ft. strands of 1⅛″ diameter; three 1,400-ft. strands of 1¼″ diameter; and topmost guys 1,575 ft. long with a diameter of 1⅛″.

Literally, this is a new height in Roebling's experience. It requires manufacturing facilities that can furnish long lengths of strand to close tolerances (actually, each guy is accurately measured, under controlled tension, in feet and inches). Plus an unrivaled experience with suspension systems of all kinds. Roebling's activities in the suspension field include: bridges, tramways, ski lifts, materials-handling, suspended roofs and, of course, guyed towers.

Knowledge gained from these activities is at your immediate disposal. Whatever you contemplate—or want to know more about — Roebling will be glad to help. Write for your copy of our Bridge Division Booklet to Bridge Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

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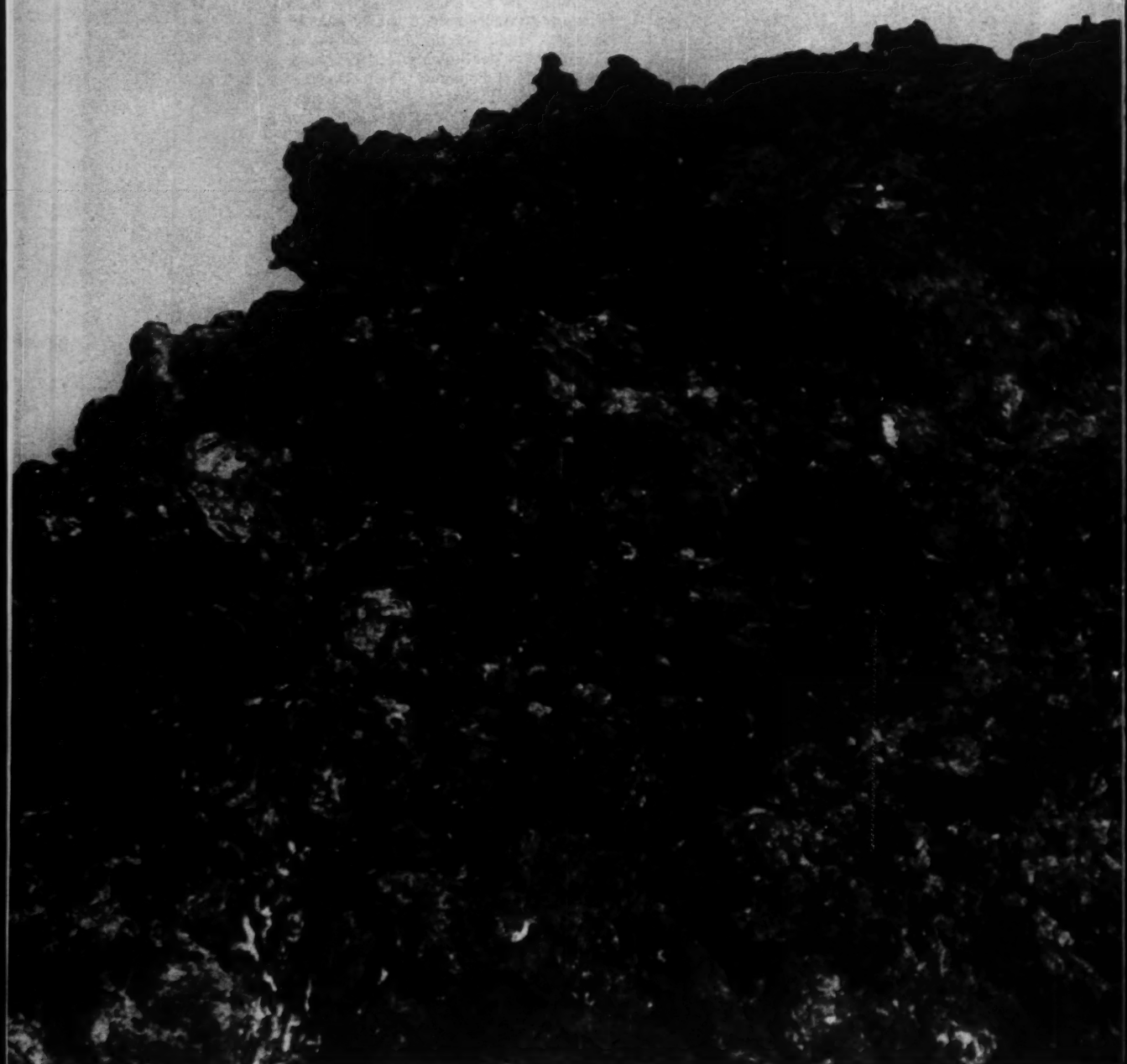
Subsidiary of The Colorado Fuel and Iron Corporation

CATERPILLAR REPORTS ON THE ILLINOIS TOLL HIGHWAY

Caterpillar is first choice

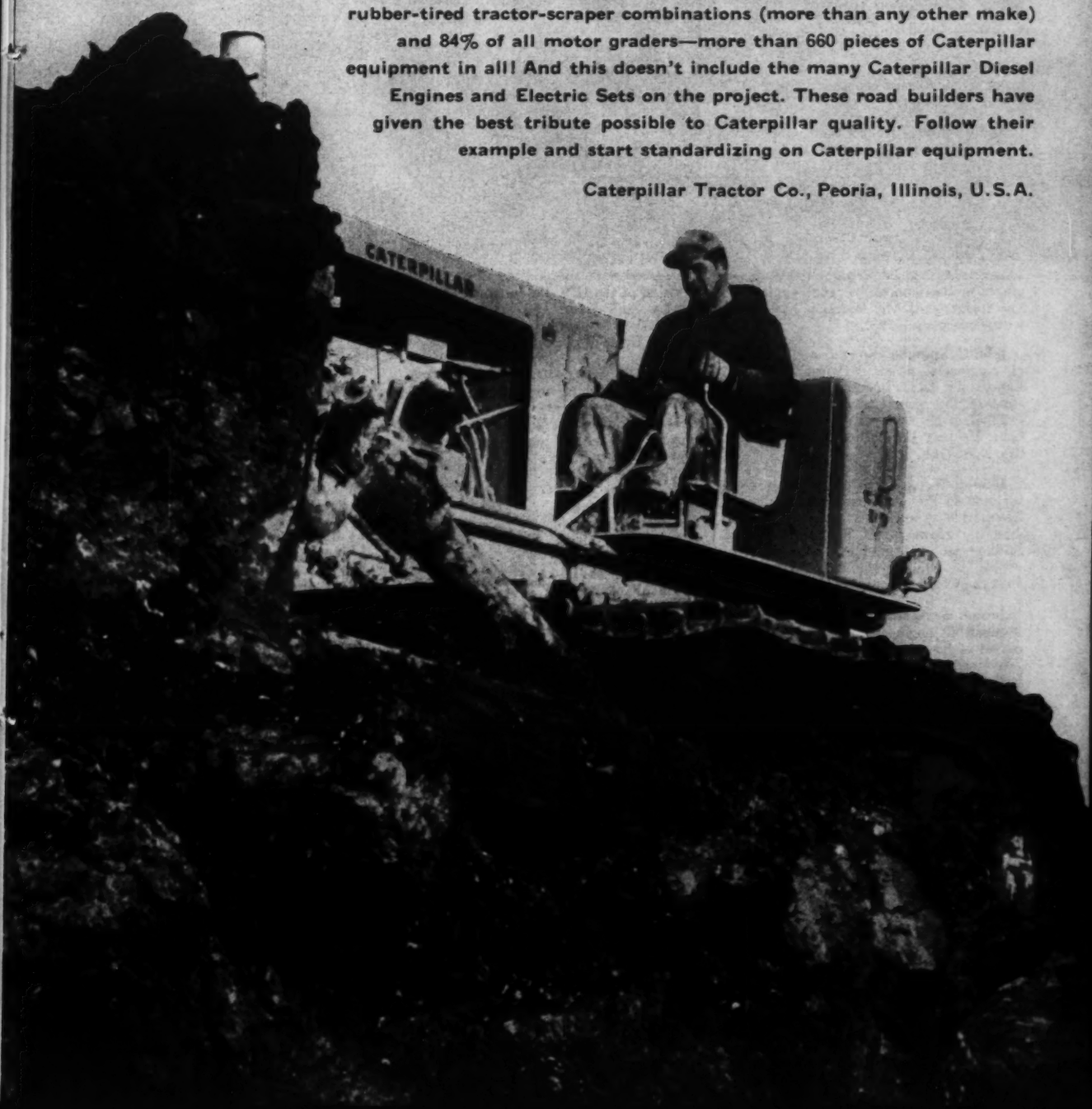
Massive Caterpillar D9 Tractor, owned by Western Contracting Corporation, digs in on the Illinois Toll Highway.



on $415 million road project

More Caterpillar-built equipment is at work on the Illinois Toll Highway than all similar machines of competitive make put together. Contractors agree, and have picked Caterpillar machines for this $415 million project. At production's peak last fall, the score was: 53% of all machines—68% of all track-type tractors, 39% of all rubber-tired tractor-scraper combinations (more than any other make) and 84% of all motor graders—more than 660 pieces of Caterpillar equipment in all! And this doesn't include the many Caterpillar Diesel Engines and Electric Sets on the project. These road builders have given the best tribute possible to Caterpillar quality. Follow their example and start standardizing on Caterpillar equipment.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.



NEWS OF ENGINEERS

Gilbert D. Henning, engineer with Warren & Van Praag, Inc., consulting engineers of Decatur, Ill., has been made an associate in the firm. Prior to 1954 when he joined Warren & Van Praag, Mr. Henning served with the Illinois Division of Highways. Earlier he was chief engineer for the Greater Rockford Airport Authority and served as chief field engineer on military and airport construction projects in the Southwest.

G. D. Henning

Karl G. Frese, Jr. has been appointed assistant branch manager of Rader and Associates' Petersburg, Fla., office. Mr. Frese has served as a designer and engineer with the firm for the past seven years.

J. Gregory Harrison, assistant engineer at Texaco's Eagle Point refinery at Westville, N. J., has been promoted to engineer in the company's plant engineering department. Mr. Harrison has been with Texaco since 1954.

John C. Sprague, director of the Corps of Engineers' South Atlantic Division Laboratory, has transferred to a post as chief of the Foundation and Materials Branch, U. S. Army Engineer District, Gulf. He may be reached through APO 205, New York, N. Y.

Harold W. Stillman, Jr., has joined the staff of the American Concrete Pipe Association as assistant to the managing director, Howard F. Peckworth. Mr. Stillman, a 1950 graduate of the University of Illinois, has been associated with the Corps of Engineers.

Joseph S. Ward, consulting soil and foundations engineer, announces the removal of his office and soil testing laboratory to 91 Roseland Avenue, Caldwell, N. J. Mr. Ward's office was formerly at Upper Montclair, N. J., and his soil testing laboratory at Little Falls, N. J.

Harold M. Sylvester has been appointed construction coordinator for Intercontinental Hotels Corporation, a subsidiary of Pan American World Airways. Mr. Sylvester recently completed an assignment as special assistant for maintenance in the Office of the Assistant Secretary of Defense.

Robert K. Duey, formerly chief engineer of the Southern Lightweight Aggregate Corporation of Richmond, Va., has been appointed structural engineering representative for Washington, Maryland and Pennsylvania.

Clinton N. Hernandez was elected to the board of directors of the Turner Construction Company, at the annual February stockholders' meeting. He has been with the company for fifteen years. In 1954 he became a vice-president and now heads the Chicago office.

Walter O. Hill, who has served the Missouri State Highway Commission for thirty-three years, retired from state service in February. Mr. Hill has had a thirty-eight-year career in highway engineering.

J. Albert Paquette of San Mateo, Calif., is the recently elected president of the Structural Engineers Association of Northern California. Mr. Paquette, is a graduate of the University of Toronto School of Applied Science. In 1932 he joined the late F. W. Kellberg, and has since become a partner in the firm now known as Kellberg, Paquette & Maurer.

Leo Weaver has accepted an appointment to the American Public Works Association headquarters staff. Mr. Weaver has served with the Sanitary Engineering Division of the U. S. Public Health Service for nine years, and last year was chosen the Outstanding Young Engineer of the PHS in Washington, D. C.

Joseph F. Jelley has opened an office for the practice of civil engineering at 222 East Bijou Street, Colorado Springs, Colo. Admiral Jelley, who recently retired from the Navy Civil Engineer Corps after thirty years' service, was Chief of the Bureau of Yards and Docks during the Korean War. He later served as Director of Construction for the Department of Defense. His most recent assignment was commander of the Tenth Seabee Brigade with headquarters at Pearl Harbor. Admiral Jelley is a past president of the Society of American Military Engineers.

J. F. Jelley

Leslie N. McClellan, assistant commissioner and chief engineer with the Bureau of Reclamation, and director of its Design and Construction Division, has retired after forty-six years of service. Mr. McClellan began his work for the Bureau as an electrical assistant and later served as superintendent of power on the Salt River Project, and chief electrical engineer for the Bureau, in which capacity he directly supervised the design of Hoover, Grand Coulee, and Shasta Power plants. Mr. McClellan became assistant chief engineer, electrical and mechanical, in 1945, and in 1948 was appointed chief engineer.

Donald Wolbrink and **William S. Pollard, Jr.,** have been admitted as partners in the firm of Harland Bartholomew and Associates, St. Louis city planners, civil engineers and landscape architects. Mr. Pollard, chief engineer for the firm since 1955, was formerly assistant professor of

Donald Wolbrink

W. S. Pollard, Jr.

civil engineering at the University of Illinois. Mr. Wolbrink, who has served as resident planner of the organization's Honolulu office since 1947, is a landscape architect and city planner whose work has included site and project planning for military installations, water resource facilities, schools and parks.

Albert F. Bauer has been appointed new head of the Department of Marine and Aviation's Bureau of Port Planning and Development, New York. Mr. Bauer has been with the Department since 1928 and served on the construction of Floyd Bennett Field and LaGuardia Field.

Carl S. Ell will retire from the presidency of Northwestern University on June 30, 1959. Dr. Ell is now serving his 48th year with the university and his 18th year as president. He joined the staff in 1910 as an instructor in civil engineering and has served as chairman of the Department, dean of the College of Engineering, dean of the Day Colleges, vice-president of the university, and was named president in 1940.

Thomas M. Berry has been named to the post of general superintendent of the Shaft and Tunnel Department for Dravo Corporation in Pittsburgh, Pa. Mr. Berry, a Cornell graduate, will supervise all construction on the ten miles of tunnel being built for the Allegheny County Sanitary Authority's sewage system project. Mr. Berry has been with the Dravo Corp. since 1948.

Earl T. Van Geem has been elected assistant vice-president-foreign operations for J. H. Pomeroy and Company, Inc., San Francisco. Mr. Van Geem previously served as chief engineer for the company's overseas support operations. He joined the company in 1950 and has held the positions of control engineer, assistant and chief engineer, and project engineer on several military, civic, and industrial projects.

CATERPILLAR REPORTS ON THE ILLINOIS TOLL HIGHWAY. FIRST CHOICE OF THE MEN

D9 (foreground) and DW21-No. 470 at work for S. J. Groves & Sons Co. on the Illinois Toll Highway.

Contractors agree:

1 *"We looked at them all—then bought Caterpillar."* **2** *"Our DW15s have worked three seasons with no down time."* **3** *"...best service of any earth-movers we've ever had."* **4** *"D9s are powerhouses, maneuverable even in the rough stuff."* **5** *"Been around Caterpillar equipment for some 32 years—and I really like it."* **6** *"We like the capacity of the LOWBOWLS—they'll go on through."* **7** *"Our No. 12s do a good job of maintaining the hauls."*

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

1 Harold Thompson, Central Engineering Co. **2** Emil Strunk, Strunk Bros. **3** Al Ensminger, Orr Construction Co. **4** Glen Roberts of McCarthy, Mass, Dillon **5** Ted Sliger, CKG Associates **6** L. E. Myers, Arcole-Midwest Corp. **7** Claire Hawn, Western Contracting Corporation

W. E. Yoder announces the formation of W. E. Yoder, Inc., a general construction company specializing in railroad track construction, engineering and maintenance, with offices in Kutztown, Pa. Mr. Yoder formerly served as vice-president and general superintendent of T. F. Scholes, Inc., of Reading, Pa.

Vaughn E. Hansen, professor of civil and irrigation engineering at Utah State University, has been appointed director of the Engineering Experiment Station at the university. Professor Hansen has done much consulting work on irrigation and drainage in South America, Europe, Africa, and Hawaii. He was recently elected president of the Intermountain Section, and is currently president of Agricultural Development and Engineering Services, Inc.

V. E. Hansen

Stanley Kimball and **Sam Ruvkun,** recently elected vice-presidents of the Henry J. Kaiser Company, have taken executive positions in the newly organized Heavy Construction Division. Mr. Kimball will be in charge of the heavy construction activities of the new department, and Mr. Ruvkun will be responsible for the Latin American activities. The new division will handle all overseas work and heavy construction projects throughout the world.

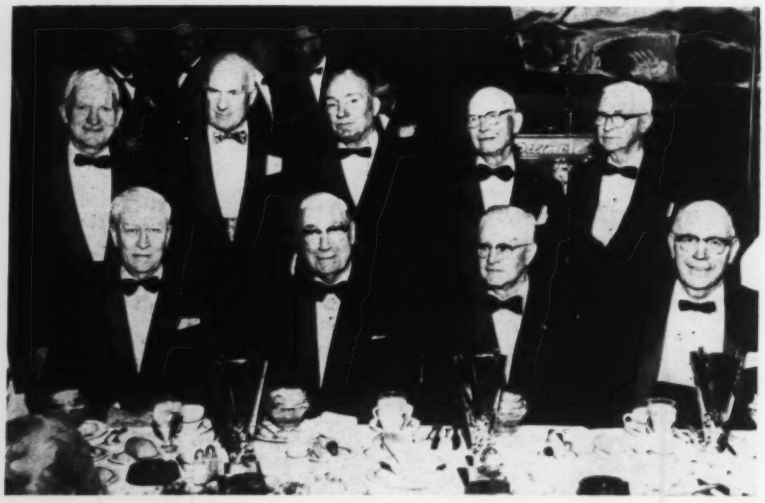
Charles D. Curtiss, who retired as Commissioner of Public Roads on January 1 (January issue, page 22), has been appointed special assistant to the executive vice-president of the American Road Builders Association. Mr. Curtiss, nationally known expert on highway finance and management, has served the Bureau of Public Roads in top executive positions for thirty-eight years.

C. D. Curtiss

Dean B. Bogart, formerly in charge of the Hydrologic Unit, Surface Water Branch, U.S. Geological Survey, Albany, N. Y., has transferred to the Survey's San Juan, Puerto Rico, office. As project hydrologist, he will establish a new field office for the Water Resources Division.

Herschel B. Miller, Houston district manager for Raymond Concrete Pile Company since 1951, has been named district manager of the company's Atlanta office. Mr. Miller has been associated with Raymond since 1945, when he graduated from Georgia Institute of Technology.

David L. Narver, Jr. has been named vice-president of engineering for Holmes and Narver Inc. Mr. Narver formerly served as assistant to the vice-president. This change was made to separate the firm's engineering and construction responsibilities.



Four ASCE members are among the nine winners of the Golden Beaver Awards, given at the Beavers' Annual Awards Dinner in Los Angeles on January 16. Shown here in front row (left to right) are, Ross White, M. ASCE; L. N. McClellan, M. ASCE; J. C. Maguire; and R. G. Le Tourneau; shown standing are G. C. Kiddoo; H. E. Hedger, M. ASCE; A. E. Graham; L. S. Corey; and R. M. Conner, M. ASCE. The Beavers was founded three years ago to honor West Coast achievement in the heavy construction field.

James G. Allen has been named to the position of secretary-treasurer of the Texas Turnpike Authority. Mr. Allen was previously assistant to the engineer-manager of the Dallas-Fort Worth Turnpike. He will have his offices in the Turnpike Operations Building, midway between Dallas and Fort Worth.

George F. Dixon, Jr., has been elected president of the Carlisle Corporation of Carlisle, Pa. Mr. Dixon has been president of Carlisle's subsidiary, the Dart Truck Company of Kansas City, Mo.

Carl W. Porter, Captain, U.S. Navy, has been appointed director of public works for Fairfax County, Va. He formerly served as Special Assistant to the Chief of the Bureau of Yards and Docks.

Arnold O. Babb, assistant chief of the Program Coordination and Finance Division, Bureau of Reclamation, left for New Delhi, India, in February. His work there is in connection with construction costs and programs for the New Delhi Division of Reclamation.

Louis McNeal Laushey, head of the department of civil engineering at Norwich University since 1954, has been appointed to a corresponding post at the University of Cincinnati. Dr. Laushey's appointment is effective September 1. Before going to Norwich, Dr. Laushey served on the faculty of Carnegie Institute of Technology.

J. J. Durkin has been named Seattle district manager for the "Automatic" Sprinkler Corporation of America. Mr. Durkin has served as a contracting engineer for the "Automatic" Sprinkler Corp. in New York City since 1946.

William R. Orr has been elected president of Structural Plastics, Inc. This new firm, which manufactures building materials from fiberglass and plastics, has its headquarters in Fort Worth, Tex. Mr. Orr, who is both a civil and chemical engineer, also heads the Construction Service Company.

Society members recently elected to honorary membership in Chi Epsilon are Emerson C. Itschner, Elwyn E. Seelye, William S. La Londe, Jr., Allen P. Richmond, Jr., Harry W. Bolin, Alexander Klein, Director Finley B. Laverty, Charles W. Dunham, Daniel S. Ling, Hamilton Gray, Lev Zetlin, Paul Baumann, Glenn C. Hunt, Director Clinton D. Hanover, Jr., Haaren A. Miklofsky, Henry A. Lepper, Frank Kerekes, James H. Lucas, Thomas C. Hanson, and Radnor J. Paquette. Chi Epsilon is a national honorary engineering fraternity.

(Continued on page 108)

CATERPILLAR REPORTS ON THE ILLINOIS TOLL HIGHWAY

First choice by count

	CAT %	NEXT HIGHEST %	TOTAL MACHINES*
All machines	53	18	1,239
Track-type tractors	68	21	499
Wheel tractors-scrapers	39	30	426
Motor graders	84	6	140

*Based on tally of machines as of October 1, 1957

DW21, owned by McCarthy, Mass, Dillon, is pushloaded by a D9 on a section of the Illinois Toll Highway near Elgin. LOWBOWL design, fast cycle time make DW21-No. 470 rig a favorite on this project.

Caterpillar manufactures a full line of earthmoving equipment—track-type tractors, wheel-type tractors, scrapers, motor graders, Traxcavators.

Each machine is scientifically designed to perform its function profitably and dependably, 24 hours a day, *every day*. Each machine is manufactured from the finest materials under the most exacting conditions to meet standards of quality that are the best in the industry. Each machine is exhaustively tested under a variety of demanding conditions, perfected before being placed on the market. Each machine is backed by a world-wide dealer organization ready to give matchless service. Each machine has the safeguard of a complete line of genuine parts, built to the same rigid specifications as the machine itself, and always available instantly at your dealer.

There is a good way to find out what Caterpillar quality and performance can mean to you. Let your Caterpillar Dealer demonstrate the equipment that's best for your job—*on your job.*

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

WORLD'S NO. 1 ROAD BUILDER

D6, owned by Central Engineering Co., 'dozes in muddy conditions on section of Illinois Toll Highway near Aurora.

DW20, owned by CKG Associates, is pushloaded by one of more than 50 D9s at work on the 187-mile road.

D8—No. 463 combination, owned by Arcole-Midwest Corp., needs its surefootedness in and out of swamp area.

No. 12, owned by S. J. Groves & Sons Co., grades an embankment. Earthmoving phase of road is near completion.

Installing riveted steel pipe in 1925 near St. Louis' Stacy Park Reservoir.

Big steel mains still going strong in St. Louis

How long will large-diameter steel mains give satisfactory service? Let's look at an example in the city of St. Louis, where many miles of steel pipe have been installed.

Back in the mid-twenties the city developed a badly needed second source of water, at Howard Bend on the Missouri River. The project included installation of a 60-in. ID riveted steel main, nine miles from the filters to a new reservoir at Stacy Park, and eight miles further to the city mains. This line was completed in 1926.

When more transmission capacity was required, the city installed thirteen miles of welded steel pipe, again mostly 60 in. ID. This pipe was coal-tar lined by the spinning method, and coated. It was supplied by Bethlehem Steel in 40-ft lengths, and joined in the field by mechanical couplings. Tests made in 1935 indicated the leakage to be less than a gallon per diameter-inch per mile of pipe in 24 hours.

After more than 30 years of continuous service for much of this pipe, and well over 20 years for the rest, the Water Department reports that it has given uniformly satisfactory service with every indication of continuing to serve well for many years to come.

Laying 40-ft lengths of 60-in.-ID steel pipe in St. Louis in 1934. Note the smooth, shiny coal-tar lining.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

6 UNITS ABREAST FOR MAXIMUM COVERAGE

6 UNITS IN TANDEM FOR MAXIMUM ONE PASS CONSOLIDATION

4 UNITS (or it might be 5) TO EXACTLY FIT JOB WIDTH REQUIREMENTS

5 UNITS IN TANDEM AND STAGGERED, VARIABLE FOR A WIDE RANGE OF WIDTHS

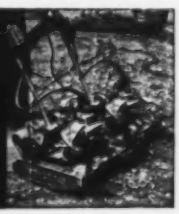
4 UNITS TOWED AT SIDE OF TRACTOR. IDEAL FOR ONE PASS WIDENING OPERATIONS.

SHOULDER COMPACTION IS AUTOMATIC. End unit automatically assumes this position — no adjustment required. Prevents raveling.

JACKSON COMPACTORS

MORE OF THEM USED ON AMERICAN TURNPIKE PROJECTS THAN ALL OTHER PAN-TYPE COMPACTORS COMBINED!

The reason is two-fold. 1. The JACKSON, with its tremendously powerful vibratory action, provides 100% of specified density of any material normally used in macadam base or sub-base courses in the shortest possible time. Each unit in the workhead supplies 4200 THREE-TON BLOWS per minute. 2. IT'S FAR MORE VERSATILE THAN ANY OTHER COMPACTOR, ideally adjustable to each and every job requirement. Coverage is what you want it to be, up to 13', 3". Any arrangement of the compactor units, as indicated at right, is quickly attainable. With this machine you can compact areas others can't touch, a factor that eliminates lost motion and saves a great deal of time and money. And, of course, it is equally effective on all types of granular soil fills and similar projects. By all means inspect it at your Jackson distributor.



Any of the compacting units in the Jackson Vibratory Compactor workhead can be fitted with operating handle and used exactly like the nationally renowned Jackson Manually Guided Compactors. Perfect for getting into odd spaces and close to walls, etc. — spots that can't be reached by other equipment. One man with a twin hookup of two of these units will compact up to 1,200 sq. yds. of granular soils in 6" layers per hour.

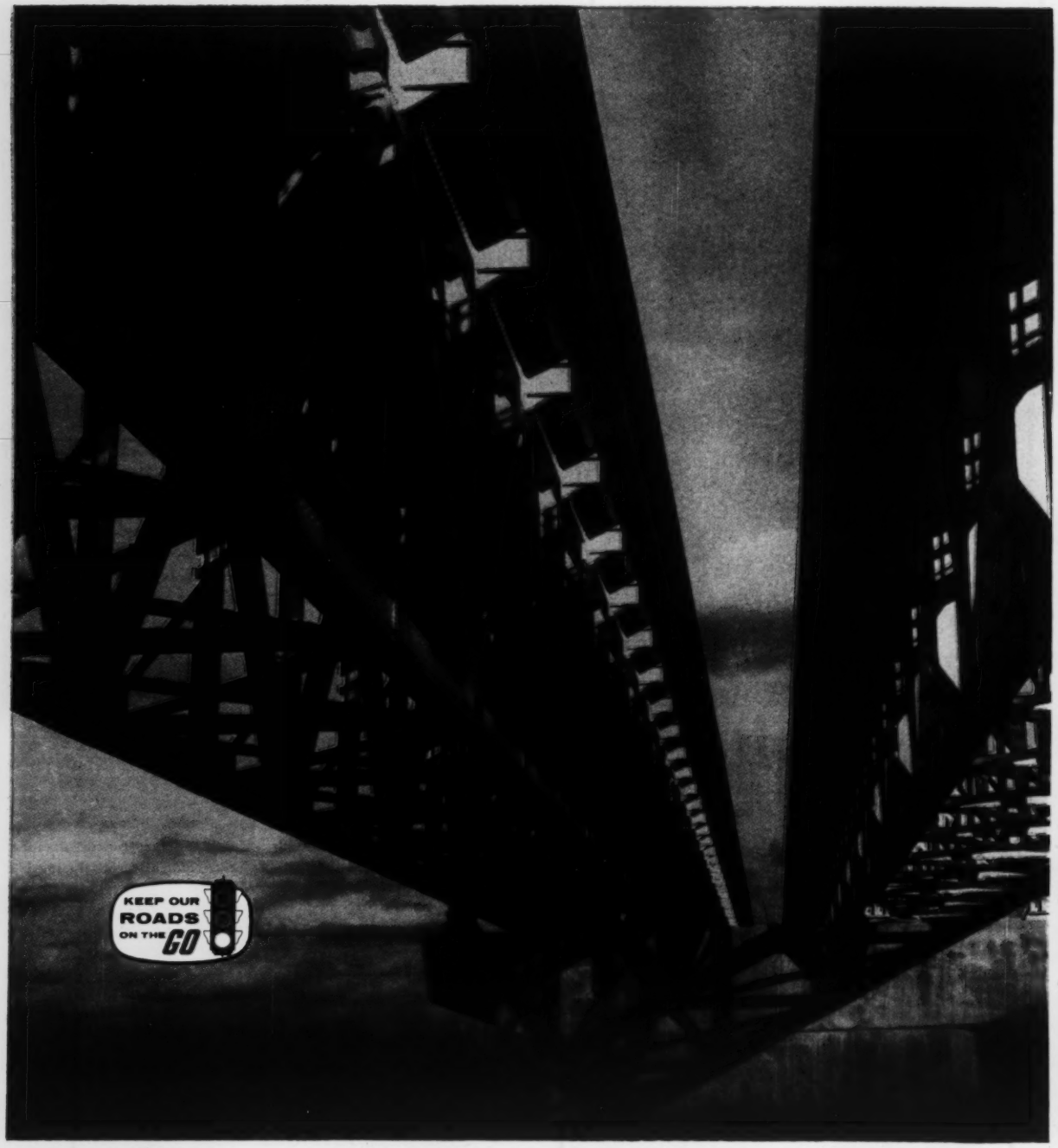
FOR SALE OR RENT AT YOUR JACKSON DISTRIBUTOR

— name and descriptive literature sent on request.

JACKSON VIBRATORS, INC.

LUDINGTON • MICHIGAN

Bridge builders save



These twin, continuous deck roadways span 2306′ across the Kaw River, on 4310 tons of USS TRI-TEN Steel and structural carbon steel.

$100,000 with USS Tri-Ten Steel

in the Kansas Turnpike's biggest bridge

THIS BRIDGE would have weighed 4,810 tons if it had been built entirely from structural carbon steel. Instead, the designers used USS TRI-TEN Steel for the more heavily stressed chords and diagonals. Because of the stronger steel, these parts could be made thinner, and lighter—*500 tons lighter*, with an estimated saving of *$100,000* in total steel costs.

TRI-TEN Steel members can be made lighter with no loss of strength because TRI-TEN Steel has a much higher yield point than carbon steel—50% higher in thicknesses of ¾" and less—and it meets fully all of the requirements of ASTM Specification A242 for High-Strength Low-Alloy Steels. Because lighter members can be used, dead weight can be reduced as much as 20%, freight costs are lower, and construction is easier.

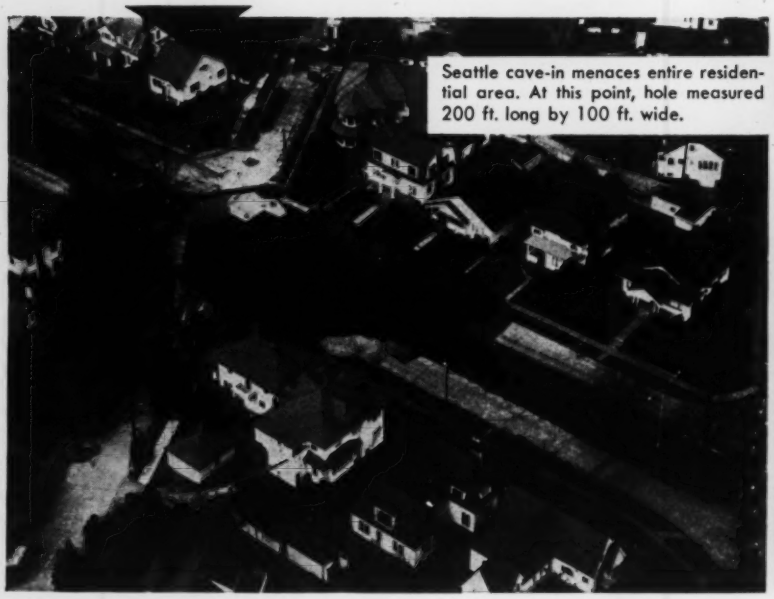
For more information about construction for maximum strength and minimum weight with USS High Strength Steels—TRI-TEN, COR-TEN, and MAN-TEN—write for a copy of "*Design Manual for High Strength Steels*," United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS, COR-TEN, MAN-TEN *and* TRI-TEN *are registered trademarks of United States Steel.*

Fisher Memorial Bridge, Lawrence, Kansas
Owner—Kansas Turnpike Authority
Designer—Howard, Needles, Tammen & Bergendoff
Fabricator—Kansas City Structural Steel Co.
Erector—John F. Beasley Construction Co.

USS United States Steel

CAVE-IN CALLS FOR QUICK ACTION



Seattle cave-in menaces entire residential area. At this point, hole measured 200 ft. long by 100 ft. wide.

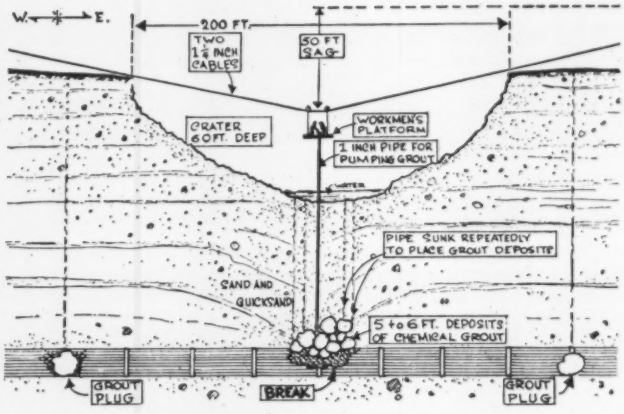
Working from swinging platform, Intrusion-Prepakt crews stabilize loose material by injecting chemical grout through pipes driven into the bottom of the hole. Flexible lines deliver grout from mixer and pump.

Emergency Grouting by Intrusion-Prepakt Halts Damage from Broken Sewer

Without warning, the city of Seattle was faced with an unexplained cave-in on Ravenna Boulevard. The size of the hole increased at an alarming rate despite the city's round-the-clock efforts to stop its progress. Shoring was attempted but failed when the 70 foot piling was swallowed up. Concrete pavement, sidewalks, trees and utility poles alike were consumed by the ever-widening crater. Homes in the vicinity were threatened, and a larger area suffered ruptured utility services.

The appearance of water in the 60 foot deep hole confirmed early fears of a collapsed trunk sewer, 140 feet below the street. Unable to cope with this creeping destruction, city authorities made a series of quick decisions. A general contractor was retained to repair the damaged sewer. The contractor called in INTRUSION-PREPAKT to plug the sewer with cement-sand grout and thus divert the flow into a hastily prepared by-pass. I-P crews then descended into the yawning pit on a cableway-supported platform, and from this precarious position, pressure grouted the loose material at the bottom of the hole with stabilizing chemicals. This halted further settling and caving, and permitted the hole to be filled to the original grade.

The Seattle cave-in is a dramatic example of INTRUSION-PREPAKT's rarely publicized ability to move in on emergencies—fast. When circumstances call for prompt, effective action, the resourcefulness and experience of I-P's world-wide organization are as close as your telephone. Immediately available is the same service that has given I-P recognized leadership in the fields of concrete construction, maintenance and planned stabilization programs. For information, contact INTRUSION-PREPAKT, INCORPORATED, 568-N Union Commerce Bldg., Cleveland 14, Ohio. In Canada: INTRUSION-PREPAKT LTD., 159 Bay Street, Toronto, Ontario.



Cross section illustrates how Intrusion grout plugs blocked-off sewer and permitted chemical grouting of loose material above break.

City Engineer—Roy W. Morse • General Contractor—MacRae Bros. Construction Co.

Photos courtesy The Seattle Times • Drawing courtesy Seattle Post-Intelligencer.

INTRUSION-PREPAKT, INC.

OFFICES IN PRINCIPAL U. S. AND FOREIGN CITIES

*Intrusion and Prepakt are trade marks of Intrusion-Prepakt, Inc., whose methods and materials are covered by U. S. Patents Nos. 2313110, 2655004, 2434302 and others, also patents pending.

Mr. Oliver Osborne scans the situation

Meet Oliver Osborne, Consulting Engineer—a man with far-reaching responsibilities. Mr. Osborne has been retained by his growing city to develop a long-range plan for its sewerage system.

Trouble is, he has been asked to consider cheap pipe... just to keep the Bond Issue low. Now, Mr. Osborne didn't get to be a Consulting Engineer on looks alone. He knows cheap pipe is susceptible to corrosion failure... doomed to expensive replacements—probably long before the Bonds are retired. No. Shortsighted plans are not for Oliver Osborne.

He sees his mission clearly: "Ethically, I can only recommend this Bond Issue be based on sound engineering economics—on pipe that will do the job for generations to come—on pipe that won't corrode and cause endless maintenance problems and eventual replacement. In short, we cannot use a design theory based on initial cost alone."

And Mr. Osborne has an answer: Genuine Vit-Clay pipe by Gladding, McBean & Co. Acids and gases won't bother it a bit... never corrodes. No need to scan the situation further. GMcB stands for *guaranteed* performance for generations... substantial savings over the long haul... 100 years dependability.

If you're in position to help with recommending, planning, engineering or installing sewerage systems, do as Mr. Osborne did—talk over your community project with a nearby GMcB representative. He's had experience in the field with shortsightedness before!

GLADDING, McBEAN & CO.

Pipe Products Division

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Look for the *pipemark* of *quality*... and the GMcB service that goes with it

EXTRA STRENGTH GMcB

ANOTHER SEVEN MILES

. . . for bridge railings on Pittsburgh's Penn-Lincoln Parkway

Again the benefits of Alcoa® Aluminum make news. On job after job, when bid against other materials, bridge railings of Alcoa Aluminum deliver highest quality at lowest cost. There's no costly, time-consuming painting. Bridges finish on schedule because with Alcoa Aluminum components you simply assemble and bolt in place. That's all. Aluminum's light weight helps jobs move faster, easier, too. And first cost is last cost with aluminum. It will never need maintenance. Four important reasons for specifying Alcoa Aluminum on your next project!

Complete engineering assistance on aluminum bridge structures, railings, highway signs, lighting standards, gratings, overhead sign structures, chain link fencing and other highway applications is available at your nearest Alcoa sales office. Or write: Aluminum Company of America, 1979-C Alcoa Building, Pittsburgh 19, Pennsylvania.

Engineers: Michael Baker Co.; George S. Richardson.

General Contractor: Adam Eidemiller; Booth & Flinn Co.; Eichleay Corp.; Ft. Pitt Bridge Co.; American Bridge Co.

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Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM

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"ALCOA THEATRE"
Exciting Adventure, Alternate Monday Evenings

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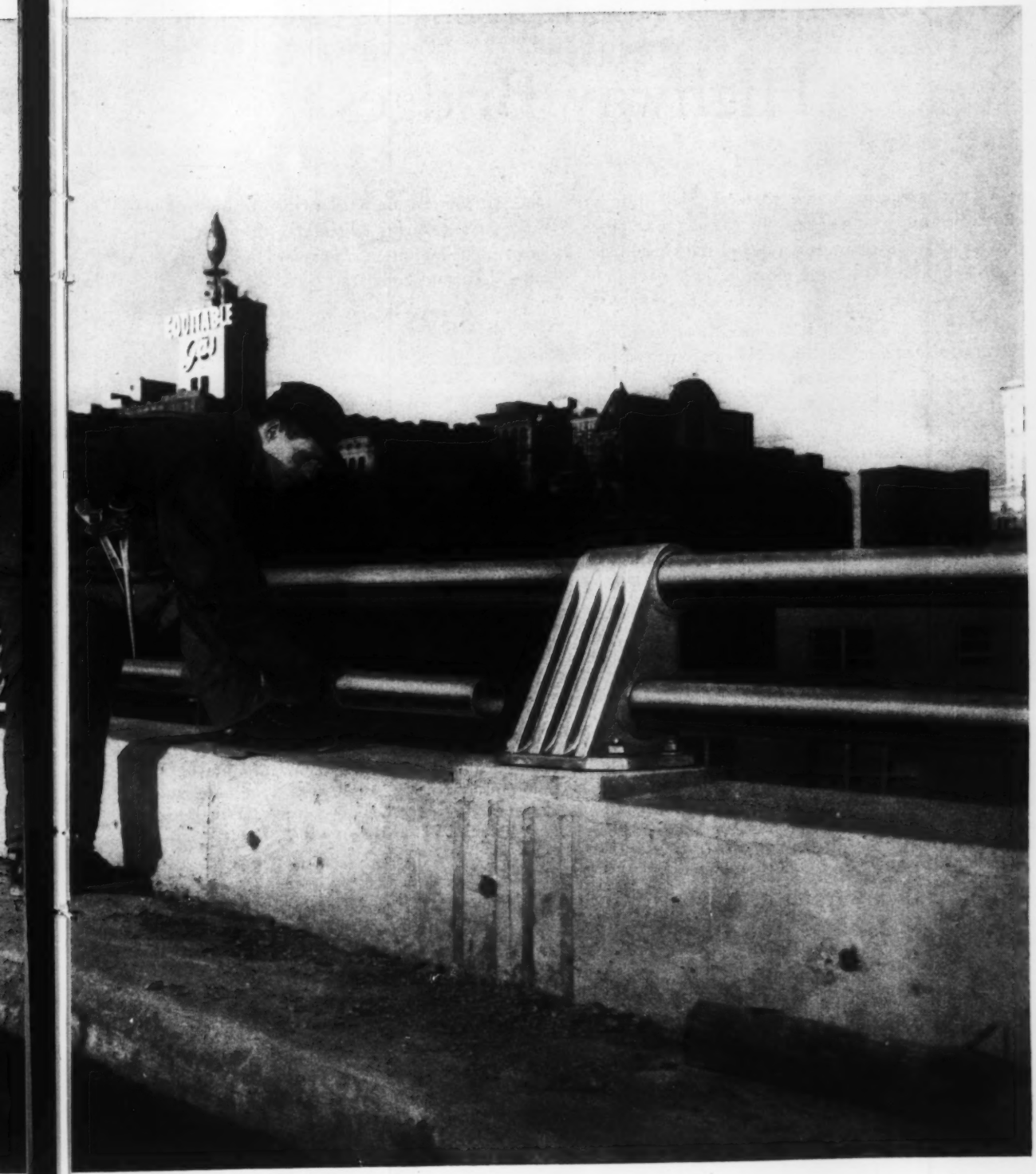

An important message to every man who designs or constructs Highway Bridges

WITH NATIONAL, state and local roadbuilding efforts beginning to dovetail, the vast highway program is on its way. How fast it moves and how much it costs depends in a large measure on the type of bridges you build.

And the facts show that, structurally or economically, steel remains clearly the best construction material you can use. For only steel combines both strength and toughness and readily lends itself to fabrication, alteration and inspection to save you time, space and dollars.

So whether you design bridges or construct them, we believe the following construction fundamentals show that steel will serve you best.

---

1. QUALITY—Steel is manufactured to precise, long-established standards. Fabrication has like standards. The result is sound construction with parts that fit precisely and material as flawless as quality control can make it.

2. STRENGTH—Steel has far, far greater unit strength than any other construction material. It permits long, clear spans . . . it's dependable.

3. TOUGHNESS—Steel is tough and ductile. It has a great capacity to take abnormal loads or impacts; and when pushed beyond capacity, steel will yield without breaking—adding a safety factor where safety is vital.

4. WORKABILITY—Steel can be sheared, drilled, punched, flame-cut, machined, welded and formed . . . it lends itself to practically every known method of fabrication. This permits extensive preassembly of material at the plant—reducing assembly forces at the site. Design possibilities are practically unlimited. And only steel gives you the advantages of bolted, riveted or welded connections.

5. ALTERABILITY—Steel lends itself so readily to change that structures can be altered during or after construction with minimum time, trouble and cost.

6. SHIPPING, HANDLING AND STORAGE—Steel's great strength and toughness means it can take rough handling. There's less weight and bulk to ship. It can be stored compactly, saving valuable space. It can be erected throughout the year and it goes up fast, saving valuable time.

7. INSPECTION—The condition of steel is obvious during manufacture, during fabrication, during erection, and years after installation. A steel structure is always easy to check visually; the possibility of human error has been all but eliminated.

Strength, Speed, Savings, Safety and Stability
all begin with Steel

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UNITED STATES STEEL

Rock-speeding Payhauler® features hit schedule-beating pace.....

ON U.S. 27

The three-unit "65" Payhauler fleet of Greer Brothers and Young, highball 2,000 cu yd of rock 1,200 feet daily. Rock-moving climbed 'way ahead of schedule, on this U. S. 27 relocation job near Lincoln, Kentucky!

Both Payhauler sizes—the 18-ton "65", and 24-ton "95"—have built-in, schedule-beating performance!

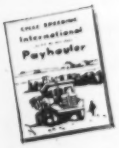
Exclusive high reverse and "zip-around" power steering gives a Payhauler regular "pick-up truck" spotting ease. The "big-target" Payhauler body speeds the shovel's dip-and-dump cycle.

Load-matched and road-matched turbo-charged diesel power gives these heavy-duty, off-highway haulers super-fast get-aways. Next-to-automatic Payhauler control gives safe, capacity-adding speed—even over rough terrain! The "65" can roll at 36.4 mph; the "95" at 38 mph!

And the double-acting hydraulic hoist, *under full controlled power both up and down*, contributes cycle-speeding 10-to-12-second Payhauler dumping!...Extra speed on every job-phase adds up to extra profit-tons hauled!

See how a Payhauler on your job will give you a decisive, profit-margin of difference! See your International Construction Equipment Distributor for a demonstration!

Find out for yourself *all about* all the big-money-making Payhauler features. Send for your free copy of this new, fully-illustrated Payhauler catalog!



International Harvester Co.
180 N. Michigan, Chicago 1, Ill.

Gentlemen:

☐ I am a contractor. ☐ Am interested in becoming a contractor. ☐ Am an equipment operator (please check square that applies.) Send me Payhauler Catalog (CR-603-G)

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A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

DOLLAR

Big Business, too, chooses Cast Iron Pipe

Fire protection line for large automotive plant in New Jersey, built with Mechanical Joint Cast Iron Pipe.

Ash disposal line for power plant in Alabama, being constructed with 12" Mechanical Joint Cast Iron Pipe.

MODERNIZED **cast iron**

FOR DOLLAR

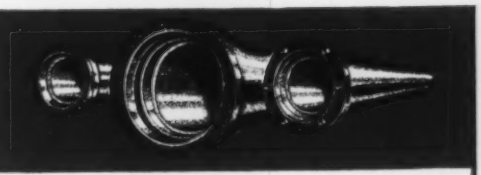
Cast Iron Pipe delivers MORE water...LONGER!

Pipe is a capital investment.

But cast iron pipe is an investment that pays off.

- *In longer life* . . . cast iron pipe serves for centuries.
- *In more efficient operation* . . . cast iron pipe requires little or no maintenance or replacement.
- *In taxpayer satisfaction* . . . cast iron pipe far outlasts the bond issue that paid for it.

Most important to you, these statements are based on proof, not claims . . . performance, not promise. Specify cast iron pipe, America's most dependable pipe, and be sure, not sorry.



6 reasons why Cast Iron Pipe is #1 choice of U. S. A.

1. HIGH FLOW CAPACITY . . .
   Cement lined cast iron pipe and fittings will not tuberculate . . . delivers a full flow for the life of the pipe.
2. LONG LIFE . . .
   42 North American cities are still using cast iron water mains laid 100 years and more ago. Hundreds more have passed the 50 year mark.
3. BEAM STRENGTH . . .
   Cast Iron Pipe is inherently tough . . . stands up under heavy traffic load, soil displacement and disturbance.
4. EXTERNAL LOAD RESISTANCE . . .
   6" Class 150 Pipe withstands a crushing load of 17,900 pounds per foot . . . nearly 9 tons.
5. CORROSION RESISTANCE . . .
   Cast Iron Pipe effectively resists corrosion . . . vital factor in its long life and dependability.
6. TIGHT JOINTS . . .
   A full range of leak-proof, low cost, easy-to-assemble joints for pipe and fittings are available for all conditions.

THE MAN WHO CHOOSES CAST IRON PIPE TODAY WON'T PAY FOR IT AGAIN TOMORROW!

CAST IRON

Cast Iron Pipe Research Association
Thos. F. Wolfe, Managing Director
Suite 3440, Prudential Plaza, Chicago 1, Ill.

pipe FOR MODERN WATER WORKS

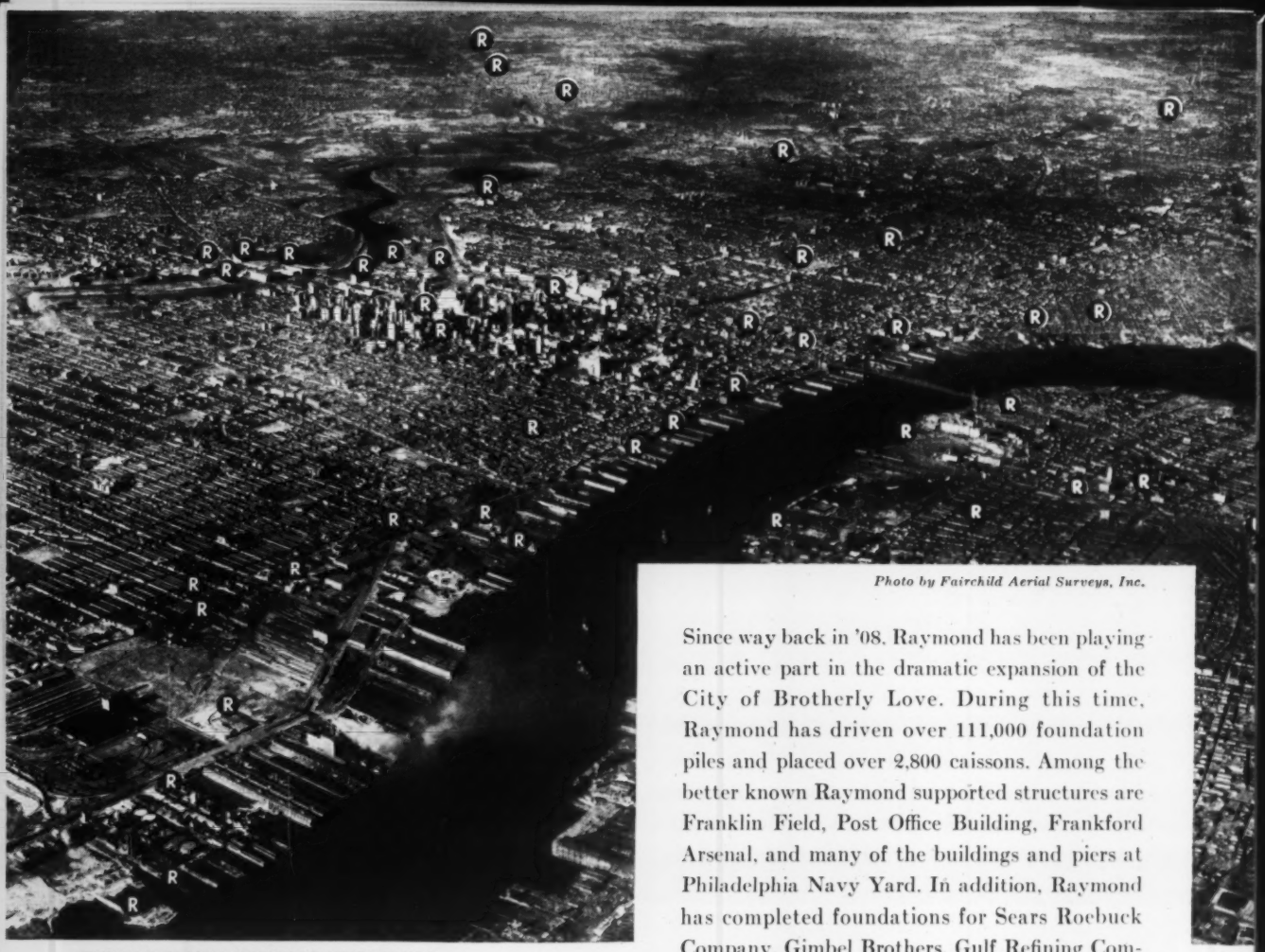


Photo by Fairchild Aerial Surveys, Inc.

THE RED CIRCLES INDICATE STRUCTURES BUILT ON RAYMOND FOUNDATIONS

In Philadelphia... 347 STRUCTURES *REST ON* RAYMOND FOUNDATIONS

Since way back in '08, Raymond has been playing an active part in the dramatic expansion of the City of Brotherly Love. During this time, Raymond has driven over 111,000 foundation piles and placed over 2,800 caissons. Among the better known Raymond supported structures are Franklin Field, Post Office Building, Frankford Arsenal, and many of the buildings and piers at Philadelphia Navy Yard. In addition, Raymond has completed foundations for Sears Roebuck Company, Gimbel Brothers, Gulf Refining Company, Phillips Petroleum, Atlantic Refining Company and well over a hundred other clients.

Across the country in other major cities, too, wherever construction is in progress, you'll likely see the blue sign indicating Raymond men and methods are at work. Talk to your nearest Raymond engineer. Let him explain how our 60 years of experience can aid you on your next foundation or heavy construction project.

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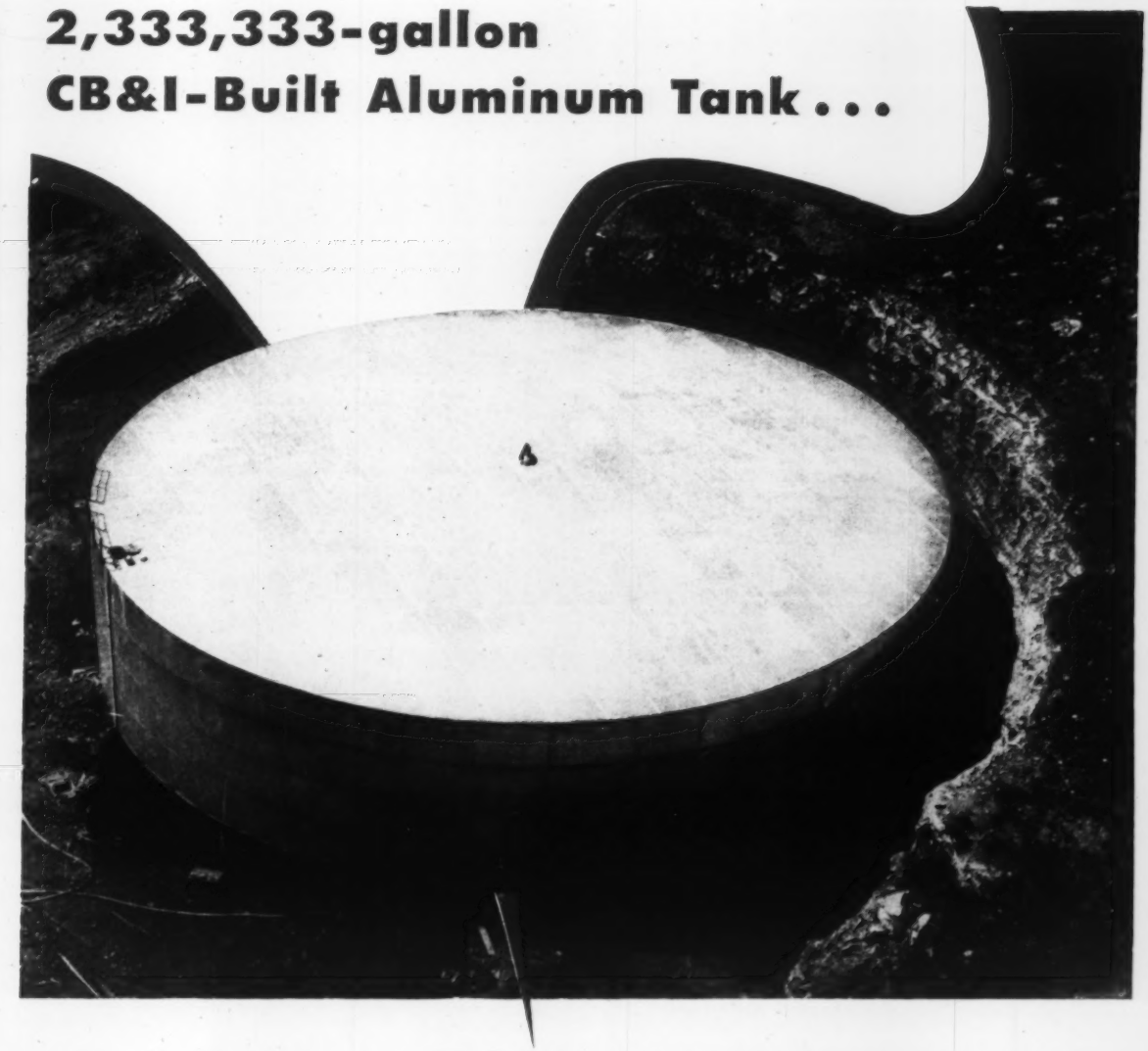
140 Cedar Street, New York 6, N.Y.
Branch Offices in Principal Cities of the United States. Subsidiaries in Canada, Latin America and other countries throughout the world.

You are cordially invited to send for our new Highway Brochure, which gives a detailed resume of how Raymond can help you and the National Highway Program. Just write Dept. C-2, Raymond Concrete Pile Co., 140 Cedar Street, New York 6, N. Y.

2,333,333-gallon CB&I-Built Aluminum Tank . . .



stores 83% ammonium nitrate

It's the world's largest all-aluminum tank. 120 ft. in diam. by 26 ft. high and constructed of more than 300,000 lbs. of aluminum, it was fabricated and erected by Chicago Bridge & Iron Company for the Mississippi River Chemical Company at Selma, Missouri. Providing storage for 2⅓ million gallons of 83% ammonium nitrate, it provides Mississippi River Chemical Company uninterrupted storage service with a minimum of maintenance.

Chicago Bridge & Iron Company has complete facilities at four plants to design, fabricate and erect special and standard plate structures of steel or other special metals to meet your most rigid specifications.

When *you* plan structures, write our nearest office . . . *and plan with CB&I.*

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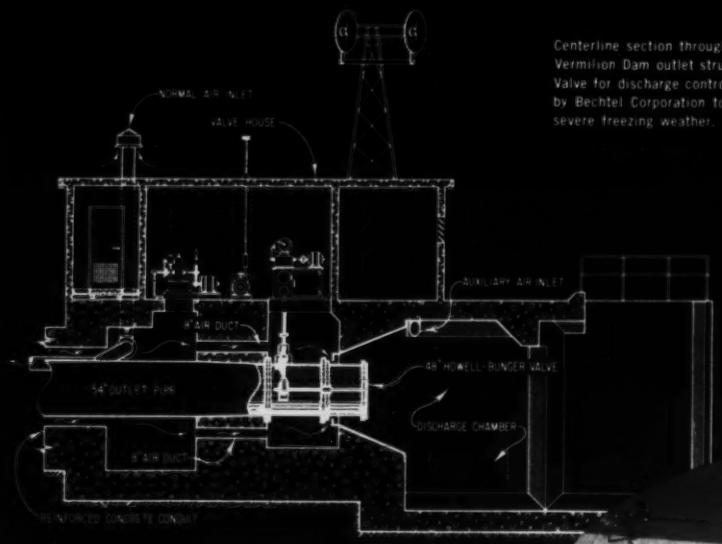
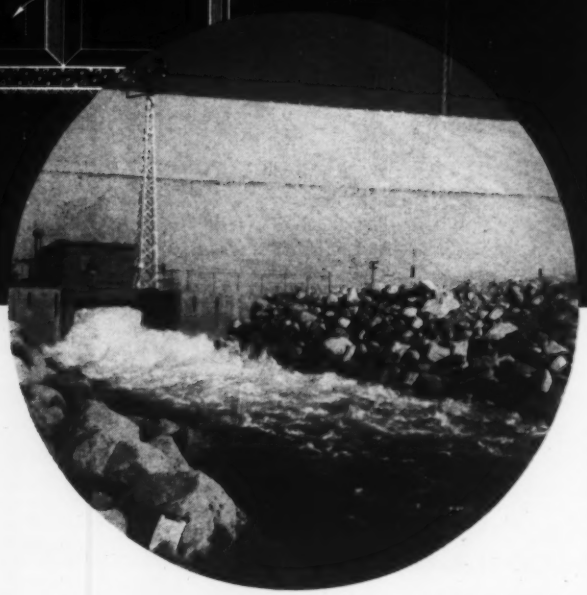


Centerline section through Southern California Edison Company's Vermilion Dam outlet structure shows 48-inch SMS Howell-Bunger Valve for discharge control. It is mounted in a chamber designed by Bechtel Corporation to minimize spray, erosion, and icing in severe freezing weather.

Valve discharging approximately 800 cfs at full gate has caused no noticeable erosion to channel in three years operation. Southern California Edison Company's Vermilion Dam and reservoir is on Mono Creek in the Sierra Nevada of California. At the Company's Portal Powerhouse on Huntington Lake, Calif., a 90-inch SMS Howell-Bunger Valve also operates under severe winter conditions by remote control.



Remote Controlled SMS Howell-Bunger Valve at Vermilion Dam Provides ***EASY REGULATION OF FREE DISCHARGE***

A 48-inch SMS Howell-Bunger Valve was chosen for Vermilion Dam to provide close, accurate regulation of releases from 10 cfs to 700 cfs. Remote control was necessary because of the isolated location of the site, and dependable operation and minimum maintenance were required, even in 20° below zero winter weather. Since late in 1954, this Howell-Bunger Valve has operated successfully under all conditions.

Rugged, simply designed and low in initial cost, the SMS Howell-Bunger Valve gives you:

- Free discharge with safe energy dissipation.
- Hydraulic balance without vibration.
- High coefficient of discharge for an energy dissipating valve.
- Minimum cavitation and maintenance.
- Simplicity of operation.
- Only one moving part in contact with stream.
- Discharge into atmosphere or under submerged conditions.

To obtain complete information, write to S. Morgan Smith Company, York, Pennsylvania.

S. MORGAN SMITH SMS **HYDRODYNAMICS**

More Power To . . . AND BETTER ELECTRICALLY

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

FRANKI FOUNDATIONS

2 WAYS BETTER

...and this is Why

1. From a dollars-and-cents standpoint, Franki Displacement Caissons can mean savings of both time and money. Due to its different method of installation and resulting high working load capacity, *fewer columns of shorter length are required.*

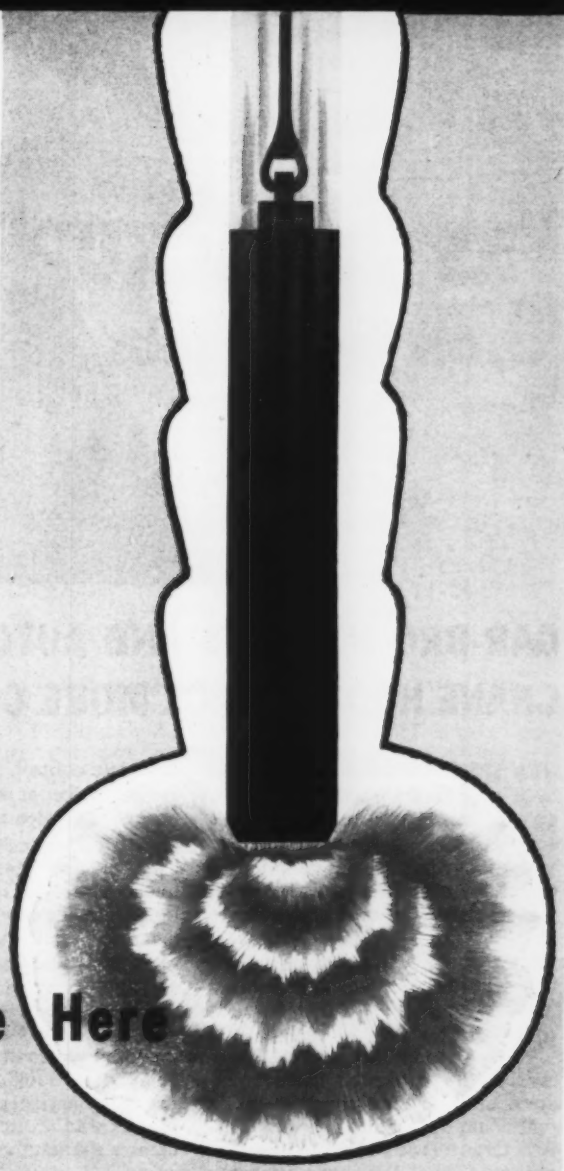
2. From an engineering standpoint, Franki Displacement Caissons take full advantage of the load carrying capacity of the soil. This is accomplished by ramming "dry"* concrete into the base, thus making in reality a pressure injected footing which, in turn, is surrounded by a compacted soil mass.

Unlike old-type or conventional pedestal piles, Franki bulb-like footings are "forged." Instead of poured concrete, they are made of "dry" concrete compacted by falling ram blows of approximately 140,000 foot pounds.

The "DRY"* CONCRETE Makes The Difference Here

Before you draw up specifications for the next foundation, be sure to investigate the advantages of the *different* Franki Displacement Caisson. At your request, a Franki engineer will call to explain all details and show examples of how Franki saved both time and money on various projects. Write or phone.

** "Dry" concrete is defined as zero slump concrete using approximately 4 gallons of water per bag of cement.*



The high driving force of 140,000 foot pounds per blow of a falling ram, many times greater than the blow of a steam or of a pneumatic hammer, "forges" the different Franki injection type footing from "dry" concrete. It also compacts the surrounding earth to exploit the maximum bearing capacity of the soil.

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GAR-BRO BUCKETS AND AUTOMATIC CRANE HOOKS PLACE MORE CONCRETE

NEW SPEED RECORDS are being set by a new combination of Gar-Bro equipment for handling mass concrete.

On many large projects Gar-Bro Concrete Buckets are being used with Gar-Bro's new power operated Crane Hooks. This combination delivers more concrete faster because it eliminates all the mechanical difficulties usually a part of large bucket operation.

Model A Gar-Bro Concrete Buckets have air controlled gates which are opened or closed by hook-on or pull chain operation. The new Gar-Bro Crane Hook which is trigger actuated gives the crane operator complete control. He can pick up a loaded bucket or set down the empty bucket and release it at will. There are no delays... no hook on problems, he merely picks up a loaded bucket and hoists it to dumping position where the concrete is dumped by means of a pull chain. The bucket is returned to loading position, released and another bucket is picked up.

This method of concrete handling obviously allows a manpower economy and eliminates the hazards and delays of a "hook on" man. All in all the combination of Gar-Bro Crane Hooks and Concrete Buckets increases the number of passes by the crane.

Gar-Bro Concrete Bucket is lowered to dumping position. Note: Crane Hook is absolutely safe; cannot open under load.

Here the Gar-Bro Crane Hook is being lowered to pick up bucket. When trigger mechanism on the hook contacts the bail, the hook closes.

Four Gar-Bro Buckets are transported from the mixer to the pour on this truck-trailer.

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. . . . . *Am-Soc Briefs*

▶ ▶ Through action taken by its new Committee on Engineers in Public Practice, ASCE is giving hearty support to recent revisions in the Federal Classification Act. The revisions are aimed at removing inequities in the grade and salary schedules of professional and scientific employees in Civil Service and at adjusting the salaries of professional engineers in the Uniformed Services. The Society's stand, which implements earlier Board action, is discussed in more detail on page 73.

▶ ▶ "A good book is the life blocd of a master spirit," wrote Milton long ago. . . . Perceptive engineers recognize that one of the most valuable services available to them as Founder Society members is the Engineering Societies Library with its 175,000 carefully chosen volumes. The Library -- housed for 45 years in the present headquarters building on 39th Street -- will be a key asset of the new United Engineering Center, when the move to United Nations Plaza is made. There is a "profile"" on the Library in the Society News section.

▶ ▶ Speaking of the United Engineering Center . . . the campaign to raise $5,000,000 from industry reached 43 percent of its goal (as of February 3) with the first 27 contributions. The campaign for member gifts is now getting underway, with ASCE Honorary Member Charles F. Kettering as honorary chairman, Past-President Richard E. Dougherty as active chairman, and Past-President Enoch R. Needles heading up the campaign for ASCE's quota. . . . Of interest is the vintage photo (page 74) taken at the dedication of our present building 52 years ago this spring.

▶ ▶ For ten years we have been following up each issue with letters to our readers -- a different 200 of them each month -- inviting them to say what they like and what they do not like about Civil Engineering. Results of the generous and helpful responses to our 1957 monthly poll will be tallied in Society News next month.

▶ ▶ Index to Civil Engineering. . . . Each member is entitled to a free copy of the 1957 Index, which is ready now. Please inform the Executive Secretary (preferably by postcard) if you wish to have a copy.

▶ ▶ ASCE Members wishing to apply for the Freeman Fellowship are urged to do so immediately. . . . The American Society of Mechanical Engineers, in its administration of the Fellowship, has announced the closing date of the competition to be March 17, 1958. Since this is contrary to the May 1 closing date previously listed in Civil Engineering, the ASME Freeman Fund Committee will accept applications for a reasonable period after March 17.

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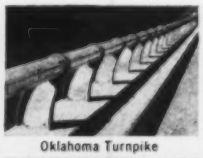
Pennsylvania Turnpike



Oklahoma Turnpike

Northern Illinois Highway

San Francisco Freeway

Dallas-Ft. Worth Turnpike

City of Denver bridges

Georgia Highway bridges

Penn-Lincoln Parkway
Calumet Skyway
Patapsco Tunnel Project
Pontchartrain (La.) Expressway
Morrisville (Pa.) Bridge
Evansville (Ind.) Bridge
Oklahoma City Blvd. Bridge

do you know that

The United States is fortunate in its water resources? Average runoff—that is total flow of all streams originating in the U.S.—is about 1.78 million cubic feet per second. This is equivalent to an average annual runoff of 8.1 in. from the entire area of the United States. Put another way, it amounts to a flow of about 1,160 billion gallons a day. Our gross water resources are estimated by D. R. Woodward, A.M. ASCE, staff engineer of the U.S. Geological Survey, in Thesis No. 143, recently issued by the Industrial College of the Armed Forces.

• • •

The turnpikes chalked up another safety record last year? Pennsylvania Turnpike records show a fatality rate of 3.3 and a fatal accident rate of 2.6—the lowest in its seventeen-year history. Best previous year for the pioneer superhighway was 1954, when the fatality rate was 4.2 and the fatal accident rate 3.2. On the New Jersey Turnpike, one of the world's most heavily traveled routes, the fatality rate last year was 1.99 compared with a rate of 2.34 for 1956, the best previous year. Rates are based on 100 million miles of vehicle travel.

• • •

Helicopters have their construction uses? In Southern California resourceful engineers have found them handy for such jobs as lifting an antenna aerial to the roof of a thirteen-story building and in pole setting in building a mountain power line. The pole-setting job, which involved placing 60 poles, from 25 to 30 ft long, in difficult terrain, took about a day and a half in comparison with the two months that conventional methods would have required.

• • •

A jet bomber can take off and land on plastic? Engineers at the Waterways Experiment Station in Vicksburg are perfecting a new plastic landing mat that will withstand the heavy loads, high tire pressures, and blast damage imposed by modern military aricraft. Resembling a giant sandwich, the mat consists of a solid sheet of plastic reinforced with glass fibers and filled with a plastic honeycomb-core material. It is made up in panels 12 ft by 3 ft by 1¼ in., with tongue-and-groove side and end connectors. The panels will be fastened together in the field by aluminum rivets.

• • •

Plenty of structural steel is available? The unexpected has happened—engineers and architects planning their projects can count on prompt deliveries of building steel in 1958. The American Institute of Steel Construction attributes the improved situation to a 29 percent increase in shipments to fabricating plants and a sizable expansion in fabricating capacity.

• • •

Disposing of atomic waste is a herculean task? Operation of the Shippingport plant brings to public attention what engineers have realized—that nothing connected with fission is more of a problem than removing and disposing of radioactive waste. In one year a plant the size of Shippingport produces almost four times as much lethal waste as does the detonation of a one-megaton bomb (fifty times bigger than the bomb which destroyed Hiroshima). With some 900 Shippingport-size reactors foreseen by 1975, we must be ready to handle an annual volume of radioactive waste equal to that from 180,000 bombs of Hiroshima size. Charles H. Weaver, vice-president of Westinghouse in charge of atomic activities, is the source of these estimates, quoted in an informative *Saturday Evening Post* article on the Shippingport plant.

• • •

The Smithsonian Institution will have a Hall of Civil Engineering? The hall will be part of the new Building of History and Technology, which will be opened in Washington about 1960. Associate Curator Robert M. Vogel will appreciate receiving models and documents showing the historical development of bridges, structures, and water supply installations—early truss systems, specimens of cables, and early rolled sections are a few suggestions.

• • •

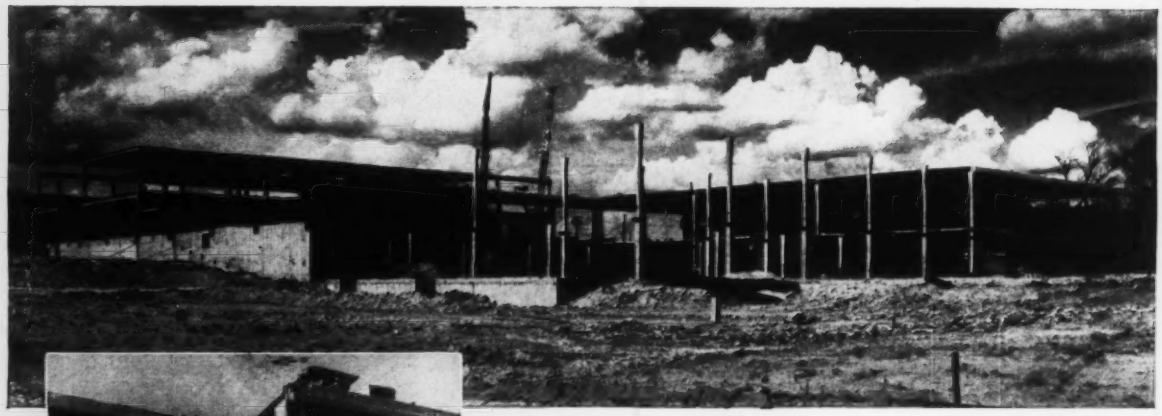
We are spending more per family for advertising than for education? In 1951, the amount spent for advertising was $199 per family, while the amount spent for primary and secondary education was only $152 per family. In a recent Capitol Hill debate on education, Rear Admiral Hyman G. Rickover added that last year the U.S. home permanent wave industry spent 2 cents per female capita on research into improving the looks of hair. "The whole nation, meanwhile, was spending only 3 cents per capita for research into the distressing things that go on inside the human head."

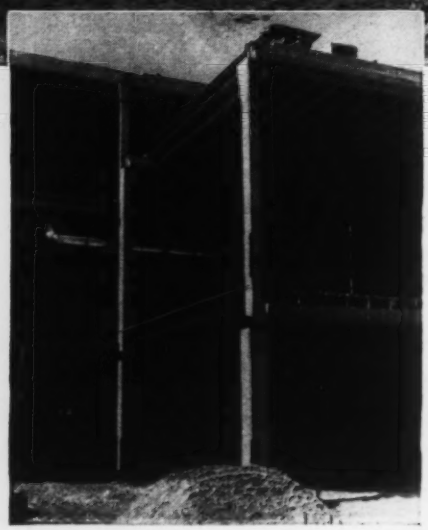
• • •

Taking good construction photos is a special art? It's an important art, too, these days, with many demands for good construction views. In the April issue the chief photographer for Uhl, Hall & Rich on the St. Lawrence Power Project tells how to take pictures for publicity, technical, and commercial use.

PRESTRESSING Adds New Values to Modern Warehousing

...'Incor' Adds Extra Quality





● Prestressed concrete is part of the answer to a designer's dream! Utilizing its amazing flexibility, he can plan vast areas of unobstructed floor space, combining the functional with the economical.

An impressive example is the new, modern fire-proof warehouse owned by the Allison Erwin Company in Charlotte, North Carolina.

Centered in the heart of the growing wholesale distribution industry in the Carolinas, the building contains a total area of 170,000 square feet. In it are stored thousands of household products—hardware, floor coverings, major appliances.

The framework—floors, girders and columns—is entirely of prestressed, precast concrete tied together with high strength concrete. All prestressed members were made with 'INCOR.'

Girders weigh three tons each; floor members up to four tons each. Columns were precast in one piece from footings to roof. All were trucked and erected in thirty days.

Here is another example of 'INCOR'* at work in the field of prestressed concrete. It makes possible new economies, new structural strengths, and new speed of erection that challenge any other construction method.

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CIVIL ENGINEERING

Elements of professionalism for the engineer

E. LAWRENCE CHANDLER, M. ASCE

Assistant Secretary, American Society of Civil Engineers, New York, N. Y.

Prepared and published at the request of ASCE Committee on Junior Members

Practice of a profession is based on specialized knowledge in a particular field of learning. It involves intellectual effort and calls for creative thinking. These are some of the attributes of professionalism. But true professional spirit incorporates a deeper, more fundamental concept. No one rightfully can lay claim to being a professional person unless he is motivated by a desire for service—service to those in his immediate circle of associates and service to mankind. This may be called idealistic. It is. Professionalism is idealistic. Without idealism there can be no true profession.

Primitive tribes throughout history have had their medicine men, rainmakers and the like. These are men set apart by reason of their supposedly superior knowledge and talents. They are respected by their fellow tribesmen. Whether or not they accomplish anything by their incantations and rituals, they hold high places in their communities and are esteemed by their fellows because they render service of a special sort. To that extent, they are professional.

We do not find it appropriate to don feathered headgear, or to smear ourselves with paint, or to indulge in fanciful dances in the practice of our profession. But it is customary to dangle keys from watch chains and place mystical combinations of letters after our names, to indicate to others that we have reached levels of intellectual accomplishment above the ordinary. There is nothing wrong with that, but such paraphernalia are only surface marks indicating the possibility that the one who uses them may be a professional person. It is only by putting to proper use the special knowledge indicated by such symbolic letters that a man earns the right to

be known as professional. Collectively, a group of men form a true profession only as they command the respect of the public and inspire confidence in their integrity and the belief that they truly are serving the general welfare.

The nature of professional service differs widely in the various professions. In engineering it is much less readily and clearly recognized than in some of the others. Little is gained by attempts to place the practice of engineering on a basis comparable with that of medicine, law, or the clergy. To one who has an infected appendix or an aching molar, or is trying to recover damages in a law suit, the doctor, dentist, or attorney who successfully relieves him of his trouble is a very real benefactor not soon to be forgotten. A relationship based on personal service for which the recipient is deeply grateful, is a strong one.

In engineering, those most nearly resembling doctors and lawyers are the consulting engineers. Even their relationship with clients is quite different from that of a doctor or lawyer. Relatively few individuals ever have occasion to engage the services of an engineer for the solution of their personal problems. And if they do it is rarely under circumstances that approach in immediacy those that exist when the help of a doctor or dentist is enlisted. The engineer is engaged in developments that, in general, serve the needs of many people. More often than not, his works benefit whole communities and, in the aggregate, they continuously affect the course of civilization, all without much realization of the service rendered on the part of those who are served.

Nor can we neglect the fact that consultants comprise a small segment of the profession. The great majority of engineers are salaried employees. Many of those in the employ of consultants may have little or no personal contact with the clients who engage the services of their employers. Many more are employed by industrial organizations and by public agencies and have no direct relationship with individual clients.

Need for professional spirit

For all these reasons, ours is quite different from the other learned professions. It is easy to understand that the service motive, cited above as the fundamental characteristic of a profession, may not be uppermost in the minds of many now included under the term "professional engineer."

Do we then truly have a profession? If so, when and how will it develop the full stature we desire for it?

If service to mankind and responsibility for the welfare of mankind are taken as criteria, engineering surely must be regarded as meriting professional status. The basic concept of engineering is the economic application of scientific principles to the wants and needs of mankind. The extent to which such principles have been harnessed for everyday application during the course of the past century is astounding. That period witnessed most of the industrial revolution. Through ease of communication and speed of transportation, the peoples of the world have been brought increasingly closer together. We have increased the supply of foods and the means of preserving them to a degree that would have been unbelievable a few generations ago. We have made possible the building of great cities and have provided the means for destroying them in the twinkling of an eye. Improperly used, the same means may bring about the destruction of our civilization. Properly used, they promise to carry us on to heights beyond our imagination.

Past developments we know. They have not been accomplished by engineers unaided, but the engineering application of scientific principles has been the foundation which has made the advances possible. The future we do not know but it is easy to believe that we will continue to progress according to an accelerating upward curve. Can there be any question that a profession that has been, and will be, to so large a degree responsible for the welfare of mankind truly needs professional spirit and awareness of the service motive?

Significance of engineering

Dean Linton E. Grinter, M. ASCE, presented a fine statement of the significance of engineering and the need for professional spirit in an address to his students. Under the title, "The Gift of Engineering," he said,

"In the beginning only divine force could have guided creation of the universe and the evolution of life on earth. All creatures endured the forces of nature until the mind of man matured. Then man's desires sought satisfaction by invention of tools to strengthen his hand. But tool making brought civilization, with collective cares outreaching the ability of arms even when aided by the lever and wheel. Slowly our forebears began to discover natural laws that explained the drawing of power from falling water, wind and steam. It was only in our fathers' time that electricity on wires, and then on wireless waves encircled the earth, yet *we* have cradled atomic change and released the latent energy that lights the stars, thereby threatening the existence of our enemies and of our own children. It is the engineer's destiny to control and direct power in order to 'provide for the common defense, promote the general welfare,' and so to help 'secure the blessings of liberty to ourselves and our posterity.'

"As an engineer you are given a favored part in this great design; without you the plan would be less perfect. When you build a bridge, design a dam, perfect a process or link power lines together you play a role in the achievement of human destiny. You therefore owe everything that you have to give in honest and sincere effort toward engineering progress. Dishonesty is inconceivable in even the smallest detail of a professional mission. Carelessness and sloth are but little less reproachable. Integrity and energy deepen the luster placed upon the profession of engineering by the master builders of the past. Disclosure of advances must be given freely to aid in educating the engineers of the future. Thus with each generation rising above the teaching of its forerunner, progress by employment of science is the gift of engineering to mankind. With this gift must go too the engineer's unending effort that ethics may mark its use and morality remain its master."

That is a fine statement of the significance of engineering and the need for professional spirit.

We are certainly entitled to consider engineering as a true profession. It is young. As recently as 1952, we celebrated the Centennial of Engineering in this country on the occasion of the one-hundredth birthday of the American Society of Civil Engineers. The profession has grown in size and importance at an astonishing rate and it is not surprising that it suffers from growing pains.

Engineers Joint Council

Through the collective activities of our various professional engineering organizations we endeavor to expand professional consciousness and to advance the science and art of engineering.

The constitution of Engineers Joint Council states that:

"The objectives of the Council shall be:

"(*a*) To advance the general welfare of mankind through the available resources and creative ability of the engineering profession.

"(*b*) To promote cooperation among the various branches of the engineering profession.

"(*c*) To advance the science and profession of engineering.

"(*d*) To develop sound public policies respecting national and international affairs wherein the engineering profession can be helpful through the services of the members of the engineering profession."

That is a broad, but very sound statement which embodies all the elements of collective professional spirit. It provides a guide for appropriate application of the principles of engineer-

ing, not only for Council but for the profession as a whole. If Council—if all engineers as individuals—will adhere to the tenets set forth in those four brief objectives, there need be little fear about the standing of our profession. Council has accomplished impressive results in keeping with its stated objectives. Many individual engineers merit our deep admiration for their devotion to those principles. Our problem is to find means to establish proper appreciation of the principles involved, and a proper sense of professional obligation, in the minds of all those we are willing to accept as members of our profession. The solution is far more difficult than with professions whose members maintain individual, personal relationships with their clients.

Most of the preceding has been rather abstract. Inasmuch as the practice of engineering involves so largely relationships between employers and employees, it is well to give thought to the practical aspects of those relationships. In its 1956 report on Professional Standards and Employment Conditions, Engineers Joint Council presented some well-considered statements on the subject. The following ten paragraphs are largely quoted from that report.

Employee's responsibilities in the engineering profession

"As an engineer, I will participate in none but honest enterprise. To him that has engaged my services as employer or client, I will give the utmost of performance and fidelity." (Faith of the Engineer.)

The engineering employee is bound by the same ethical and moral principles that apply to a member of any learned profession. It is axiomatic that just as management has responsibilities to employees, so do employees have responsibilities to management. The engineer employee should realize that he is not just another hired hand, and his employer is not expected to treat him, or consider him, as such. He should know that to achieve full professional stature he must develop himself to rise above the technician or engineering assistant. He must have a genuine desire to expand his capacity, to extend his knowledge, and to improve his proficiency.

The responsibilities of an engineering employee are many. He is obliged to perform the professional assignments entrusted to him to the best of his knowledge and ability. He should give needed professional counsel in his special field and render loyal service. He should respect the economic problems of his employer. He should be thorough, expeditious, original, and accurate in the execution of his duties and assignments. He should have a rational attitude toward his work and fulfill each task with a minimum of supervision. At all times he should strive to improve the quality and increase the quantity of his output. Not only are these the necessary attitudes of a truly professional man, but they are also prerequisites to advancement and prestige.

Any employee who is unwilling to assume responsibilities beyond those accompanying his present job has little right to be critical about lack of advancement. If he feels that he is not getting earned recognition, it may well be that critical self-appraisal is in order. One cannot just wish oneself up the ladder to success or depend on someone else to push or pull one along the way. The fact that a man has acquired a bachelor's degree in engineering does not, of itself, entitle him to any lasting professional recognition. It remains for each individual to prove by his own ability, integrity, and conscientious application to duty that he deserves recognition.

Education is important to the engineer and he should foster its continuance for those who are subordinate to him. He should strive to recognize and to utilize the diverse capacities of all his fellow employees. He should strive for good planning and clear, concise reports. He should be friendly and maintain good appearance. He should develop ability to be a good listener as well as to express his thoughts effectively.

Employer's responsibilities in the engineering profession

Surveys show that more than 40 percent of those in industrial management have been trained as engineers. It seems illogical, therefore, that often there is inadequate communication between management and engineers with consequent lack of understanding, on the part of management, of the reasons for dissatisfaction among professional employees.

Management must recognize the inherent professional character of engineering work. It should be a policy of management to utilize its professional employees to the maximum of their capabilities. Except during the training period, the engineer should not be assigned to tasks which do not require his technical training. He should be accorded individual and professional status commensurate with the quality of his contribution.

There must be opportunity for a continuation of education. It is important that professional employees be given opportunities to participate in the activities of scientific and technical societies. It is important that they receive credit for their contributions to the advancement of technical knowledge or to the profession as a whole.

There must be adequate communication between management and the professional employee. There should be organized orientation and training programs for new employees. Engineers need to understand the basic policies of their employer. They need to know their responsibilities and their opportunities for advancement. Adequate management-employee communications require a day-to-day relationship supplemented by periodic performance reviews, and other appropriate techniques.

Salaries must be established that will recognize the contribution of professional employees as related to that of other groups. Salary differentials between various levels of technical experience have been substantially narrowed during recent years. Engineers who, after a period of satisfactory employment, find that their salaries are only slightly higher than those of a recent graduate, and possibly lower than those of a skilled craftsman, are not working in a favorable atmosphere.

Management must minimize the fear of job insecurity by adopting feasible means for stabilizing the employment of professional personnel and suitable termination policies. Since many engineers become managers, there is need to insure that they are employed and developed in an atmosphere which will fit them for their future responsibilities. Executive talents must be developed by experience and training in those phases which lead to managerial responsibilities.

Collective bargaining

Discussion of the mutual responsibilities of management and employees leads to a consideration of the problems related to collective bargaining.

What about collective bargaining by professional people? Is it compatible with professional concepts? Does it offer a means of advancing the status of an individual or of the profession? Does it tend toward unification of the profession or, by creating antagonism and dissention between employer and employee, lead to disruption? These are the types of questions that con-

front engineers under some conditions of employment.

Those who advocated the professional employee provisions of the Taft-Hartley Act did not at all have in mind encouragement or approval of collective bargaining by engineers on a large scale. The statute was designed to free professional people from unwilling inclusion in heterogeneous labor unions. Also, it permits a group of engineers to form an organization of their own in the event they decide that collective action is the only way to bring about improvement in conditions existing in their particular place of employment.

Although bargaining groups have been formed in various parts of the country, a very large majority of Society members express opposition to collective bargaining for professional employees. Those employees who have met the standards of professional competence required for membership in a national professional engineering society properly may be considered as being in the upper ranks of the profession. Four national societies conducted polls in 1953 to determine the current status and thinking of their memberships relative to collective bargaining. It is significant that some three-fourths of them were averse to this type of action. Less than 4 percent of the members were included in established collective bargaining groups for professional engineers. An opinion research sponsored by ASCE, in 1957, showed even stronger opposition, with 84 percent believing that engineers should avoid collective action. These men of high professional standing find a basic conflict between true professionalism and collective bargaining.

ASCE never has adopted a stand of unalterable opposition to collective action, taking into account the fact that occasional circumstances may provide some justification for it. This is not to be accepted as general approval of unionism or of collective bargaining as a proper concept of professional conduct.

When engineer employees are confronted with the necessity for a decision as to collective action, it is well to bear the foregoing in mind. It is important to consider whether the prospect of some immediate advance in salary or working conditions is sufficient to outweigh the sacrifice that goes with the accompanying loss of independent action and pride in individual accomplishment.

Why are we troubled with collective bargaining anyway? Surely engineers do not engage in it just for the sake of bargaining. The trouble behind it is an unsatisfactory relationship between employees and employers. In spite of the readily acknowledged importance of engineering services in modern life, it seems that engineer employees often receive rather short shrift from their employers. With proper recognition of the contributions of engineers and of their potentialities, it seems logical that employers should endeavor to accord them treatment that would encourage their best efforts and make them satisfied with their employment. Every move to that end is a move toward eliminating the likelihood of collective bargaining.

Society activities

ASCE's Constitution states that "The objective of the Society shall be the advancement of the science and profession of engineering."

Every one of the Society's far-flung activities is directed toward furthering that mandate. It is not reasonable to divorce what commonly is referred to as technical activity from professional activity. The two are interlocked. Each is essential to "advancement" and neither can hope to provide adequate results without the other. However, some phases of Society endeavor can be pointed out as specifically applicable to the subject of this article.

The Code of Ethics epitomizes proper standards of professional ethics. Every member pledges himself to observe the tenets of the Code when he enters the Society. Recognized violations of the Code are relatively few in number and the Board of Direction takes disciplinary action when such cases come before it.

Standing committees which maintain continuing activity in the field of professionalism are grouped in the Department of Conditions of Practice. The Committee on Student Chapters carries general responsibility for operation of the many Chapters in schools of recognized standing throughout the country. Thus the Society endeavors to inculcate and develop understanding of the precepts of professional conduct in young men before they become members of the profession. The Committee on Engineering Education is vitally interested in the same objective.

Through the Committee on Junior Members, a constant effort is made to properly integrate new graduates into the profession and to stimulate professional consciousness in the younger members of the Society. It is through the activities of Local Sections that this kind of endeavor can be most effective not only among the younger men but for all members. The Committee on Local Sections provides official liaison between the Sections and the Committee on Conditions of Practice.

The Task Committee on Professional Development is charged with making a study of the professional attitudes of our young men and developing recommendations for appropriate action in this direction.

The Committee on Professional Practice, as its name indicates, is concerned with the problems that continually arise in connection with the actual practice of engineering. This is an important committee and the scope of its work is broad.

These are some of the means by which ASCE works toward increasing the awareness and the development of a professional spirit among its members.

Responsibility to community

In the opening paragraph of this article it was stated that a basic attribute of a professional person is a desire for service. A well-rounded life encompasses service beyond one's professional duties. A competent engineer possesses qualities that fit him for civic and social activities in his community and he should accept opportunities for useful service. Any professionally minded engineer should consider it a part of his duty as a good citizen to devote some part of his time and ability to community activities. Many do.

Engineering judgment and experience are strong qualifications for membership on the governing body of a community, on legislative bodies, planning commissions, school boards, church groups, chambers of commerce, and advisory committees in a variety of civic efforts. Opportunities always will be available to those who wish to be of service.

Personal responsibility

Every member of the profession should realize that he has a responsibility to it. The mere fact that he is gaining his livelihood as an engineer results from the contributions of many thousands who have gone before him, whose efforts have made the profession what it is. No man worthy of being called a professional engineer will fail to try, according to his abilities and opportunities, to contribute to the basic fund of technical knowledge; nor will he fail to uphold and advance the ethical standards of the profession.

There is one whose professional stature each engineer needs to be concerned about, and has it within his power to develop. That engineer is himself. The integrity of the profession is the sum total of the integrity of all its members—nothing more, nothing less.

GORDON C. LINBERG

Project Manager, Merritt-Chapman & Scott, Wolcott Avenue Bridge, Hartford, Conn.

M. SCHUPACK, A.M. ASCE

Vice President and Chief Engineer, The Preload Co., Inc., New York, N. Y.

Wolcott Avenue Bridge nears completion. This cast-in-place, post-tensioned structure 1,677 ft long, spans Connecticut River at Hartford. To right of bridge is construction road consisting of fill and anchored barges.

Concrete set slowed down to step up bridge construction

Retarding the set of concrete for 8 or 10 hours speeded completion of the 1,677-ft Wolcott Avenue Bridge over the Connecticut River at Hartford by several months. Keeping the concrete plastic until an entire unit had been placed and all deflection had occurred in the falsework, and then revibrating the entire concrete mass, provided a potentially strong structure for early post-tensioning. This relatively new technique made it possible to cast in place 28 simple spans 120 ft long in 14½ weeks, using only three sets of falsework. Actually there are 14 spans in the bridge, each about 67 ft wide and 120 ft long. Each was constructed in two completely separate parts each 33 ft 10 in. wide, and the falsework was reset for the second half of each span.

The structure is the principal link in Connecticut's new Route 6 bypass north of Hartford, just completed for the Greater Hartford Bridge Authority. Its 120-ft spans, with two 29-ft roadways separated by a 4-ft median strip, make it one of the outstanding prestressed bridges in the United States. Merritt-Chapman & Scott Corp. took the contract on a precast, prestressed design at $3.5 million. This cost is exclusive of pipe for piling and steel sheetpiles, the latter to be left in place for protection of the river piers. These materials were purchased in advance by the Bridge Authority.

Specifications stipulated that the contractor engage a consultant experienced in prestressing. Merritt-Chapman & Scott engaged the Preload Co., Inc., and utilized their experience to work out alternative methods of constructing the bridge, considering the contractor's work methods and the large inventory of heavy equipment available for construction.

The original plan was based on precasting T-beams and prestressing them in the casting yard before setting the 120-ton units. Narrow sections of slab were to be cast later in place between the T-heads and the deck surfaced with 2 in. of asphaltic concrete (Fig. 1, left side). An alternate design of precast composite construction, requiring casting of the entire slab in place, was discarded. The adopted plan, also shown in Fig. 1 (right side) is a cast-in-place design based on concreting an entire span, in half widths, as one continuous unit utilizing 5,000-psi concrete. Four 7-ft-deep girders are integrally cast with the 7¼-in. deck. It was estimated that the bridge could be cast in place with no more difficulty, and at the same cost, as a conventional prestressed concrete superstructure made up of precast T-beams. On the basis of reduced construction time, and no additional cost, the Bridge Authority accepted the alternate on recommendation of its engineers.

The adopted design was worked out from sketches prepared by the Preload Co. The plans were made within the same engineering framework as was

Above: Transit-mix trucks move on deck five days after concrete placement, as work proceeds simultaneously on several spans.

At right: Prefabricated cages for girders are assembled on construction road, then hoisted to deck. Note that floating barges form part of construction road.

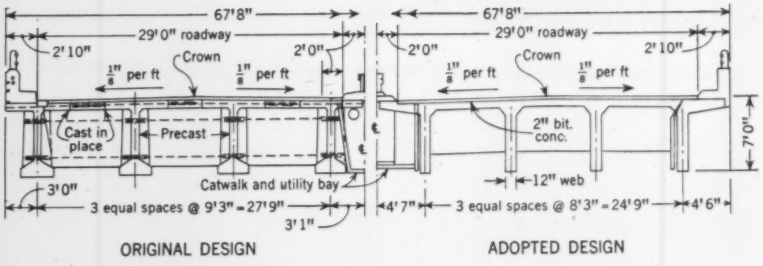

FIG. 1. Original and adopted cross sections are seen in left and right halves.

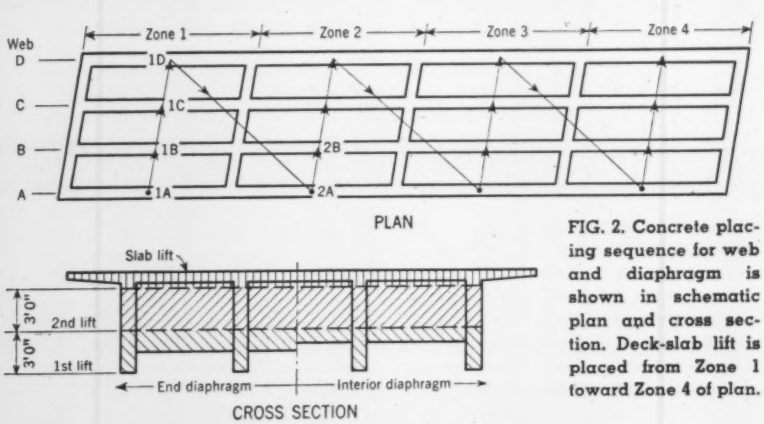

FIG. 2. Concrete placing sequence for web and diaphragm is shown in schematic plan and cross section. Deck-slab lift is placed from Zone 1 toward Zone 4 of plan.

the original design. DeLeuw, Cather & Brill was the general consultant to the Greater Hartford Bridge Authority. Thomas Worcester, A.M. ASCE, of Boston, was the design consultant for the bridge and its approaches.

The challenge in preparing the alternate design was to choose details and methods that would permit speedy and economical construction. In selecting the cast-in-place design, Merritt-Chapman & Scott was not choosing a design alone, they were also adopting a method of construction. A million dollars worth of machinery and special equipment were employed on the project.

The pier foundations are reinforced concrete units 16 x 84 ft and elliptical in shape. Two of the piers are founded on rock; the others rest on pipe piles. All were constructed within steel sheetpile cofferdams with the sheetpiles left permanently in place. Above low water, granite-nosed piers 6½ ft thick at the base taper ¼ in. per ft to a height of 45 ft. The bridge will provide a waterway clearance 100 ft wide and 50 ft high for vessels although there is no river traffic at present. Cofferdams and pipe piles were installed by floating equipment.

The contractor developed a novel means of using land based equipment for nearly all the superstructure work. An earthfill road was built 440 ft out from the west bank. From there to the east bank, two 325-ft steel railroad car-floats were used as a road and work platform. As many as ten cranes of 15- to 50-ton capacity, with other land and floating equipment, made this a mass production job as it progressed across the river.

Key to progress was moving the falsework. This depended on: (1) quick setting of support trusses, (2) rapid preparation of forms and placing of reinforcing steel, (3) rapid strength development of concrete (72 hours to the point where it could be post-tensioned), (4) initial stressing of the concrete to release the support, and (5) speedy movement of falsework to the next location.

By carefully planning every part of the work, it was found that three sets of falsework would meet the required schedule of 28 half-width spans in 99 days. This meant completing two units every week and an extra unit some weeks. Each set of forms and falsework was used for a complete cycle each 5 or 6 days.

Each falsework unit was built 116 ft long, to just fit between the piers, and consisted of four Warren trusses, one located under each of the bridge girders. The falsework was designed and constructed by Merritt-Chapman &

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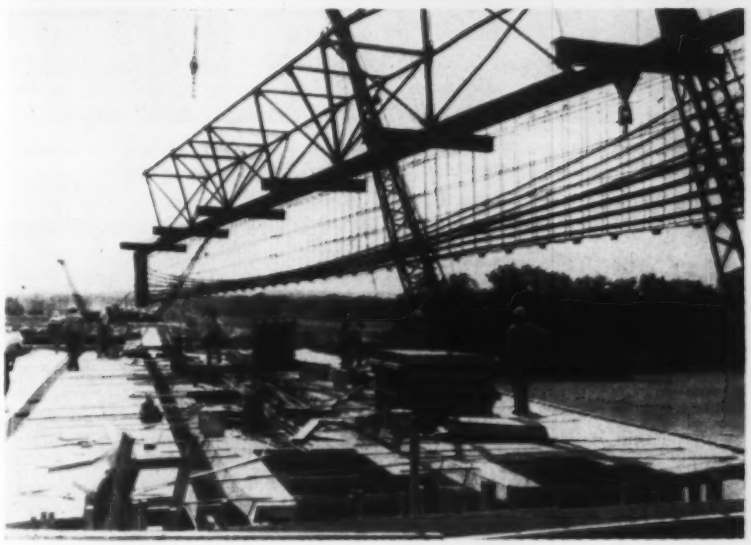
For falsework, four Warren trusses were specially built. Each stands on 5-ft legs with built-in sand jacks. At each end of truss, steel bent transmits load directly to pier base. Truss is moved to next position by two barges, tied together and equipped with steel bents fitting under truss quarter points.

Scott using available 14 H 73 main members. For ease in fabrication, these were laid flat. Movable legs at each truss facilitated lowering the falsework 4½ ft for moving. Each unit cost $30,000, and an additional $8,000 was invested in fabricating jigs. This large investment made it worth while to keep the number of units to a minimum.

The trusses were moved in on a barge specially equipped with lifting frames. Since the falsework trusses fill the length between piers, they are self-centering as they are floated in and set down on steel bents resting on the wider foundation. The moving schedule for each of the support units was to complete the half-width of a span and then transfer to the other half of the same span. Falsework Unit 1 was then leap-frogged around Units 2 and 3 to the next open span, where it again served the two half-widths successively. Wood decking was placed over the steel truss to support the formwork and to avoid the transfer of secondary stresses into the truss as the load changed during concreting and prestressing.

To shorten the preparation time for concreting, the steel was completely preassembled, with precast concrete end blocks, for each of the four girders. The end blocks contain the Freyssinet cones of 5-in. diameter for anchorage, and had the bridge sole plate attached. These were cast well in advance of use and in the horizontal position. Concrete was carefully placed around the embedded material and had its full design strength by the time of loading. Twelve Freyssinet cables, each consisting of twelve wires 0.276 in. in diameter, encased in a flexible metal hose, are used in each girder with stirrups and some small horizontal bars. The flexible metal hose is positioned in

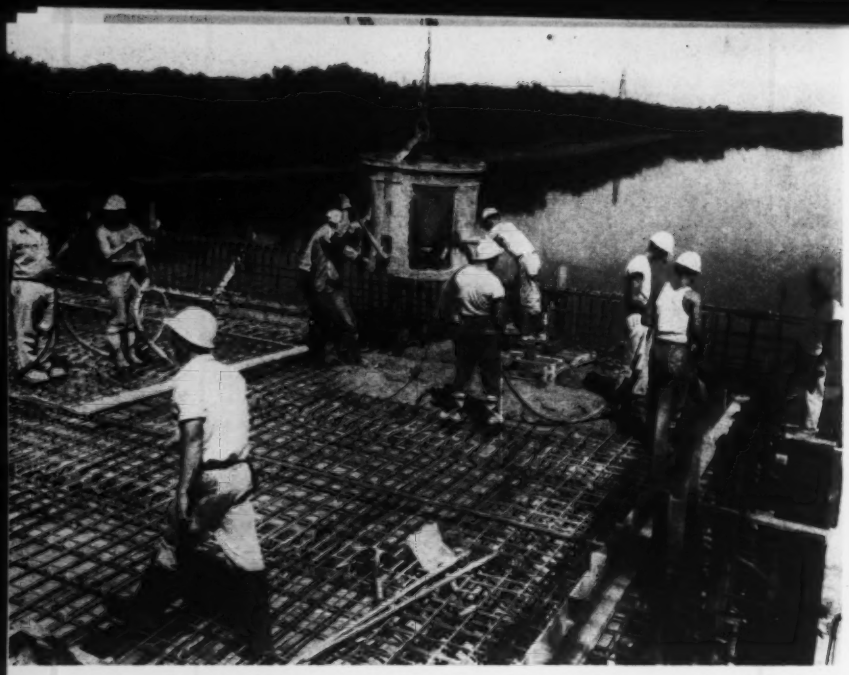


Ten-ton reinforcing cage is hoisted from assembly point on construction road by two cranes, then dropped into slot 12 in. wide left in formwork for its insertion (above). Bridge shoes are already attached to girder's precast end blocks. These blocks rest directly on pier, as seen at right, where post-tensioning of cast-in-place girders has been completed.

TABLE I. Result of partial prestressing on an interior girder,* shown in Col. 5

	(1) P/A	(2) P_e/Z	(3) (1) + (2)	(4) M_{DL}/Z	(5) (3) + (4)†
Top fiber	+ 556	− 1036	− 480	+ 850	+ 370
Bottom fiber	+ 556	+ 2194	+ 2750	− 1790	+ 960

*Stresses in psi. Plus stresses are compression; minus, tension.
†Temporary stresses with 8 of 12 cables stressed.



After webs have been revibrated, deck is cast. Then vibrators are inserted through fresh deck slab and 12 in. into webs, thus welding lifts into one monolith.

the cage, and the twelve-wire cable pulled through the hose with a power winch.

The steel was assembled on the roadway handy to the piers. Two cranes, using a pipe-and-beam lifting device, set the assembly in the forms. Deck and diaphragm steel was set in one day while forming was completed.

Concrete kept plastic eight hours

The big problem with the concrete was to keep it plastic for 8 to 10 hours yet have it strong enough for prestressing and removal of supports in two days. The theoretical deflection of the 116-ft-long supporting structure is 2 in. under the load of 240 cu yd of concrete. To avoid excessive stress and consequent cracking of the web as deflection occurred, the concrete had to be completely plastic.

High early-strength concrete was obtained by using a rich mix with a low water-cement ratio, made possible by the addition of Plastiment. Plastiment retards the hardening of concrete by retarding only the initial set. Normally the strength curve of such concrete catches up with that of concrete without the admixture at about 1,200 psi and then exceeds that of ordinary concrete.

Concrete was made with trap-rock aggregate of 1½-in. maximum size, 8 sacks of Type I cement, Darex to give 3 to 4 percent of air entrainment, and up to 4 oz (at 85 deg F) of Plastiment per sack of cement. Only 4 gal of water per sack of cement gave a concrete with a 4½- to 5-in. slump and good placeability.

Edwin Balf Co. of Hartford furnished the concrete, delivered dry in transit-mix trucks. The water and liquid Plastiment were added to the mixer drum in metered amounts from a specially built tank. The concrete was mixed for 15 min and immediately placed by crane and bucket. This procedure was suggested by DeLeuw, Cather & Brill and was very effective in obtaining a uniform concrete.

The webs and diaphragms were cast in 3-ft lifts, as shown in Fig. 2. After the second lift was placed, a two- or three-man crew revibrated the webs and diaphragms, penetrating right down to the form bottoms. The vibrators were inserted every 2½ ft for about 15 sec to achieve a denser concrete and ½-in. consolidation. The webs were completely plastic, even 3 to 4 hours after being cast. After the deep forms had been completely filled, a minimum waiting period of 2 to 3 hours was required before concrete was placed in the deck. Concreting was so scheduled that this waiting period did not slow placing.

During deck placing, the vibrators were inserted through the fresh deck concrete about 12 in. into webs and diaphragms. A roller screed gave the deck a rough finish. Wet burlap was then used to cure the deck. When the formwork was stripped 24 to 36 hours later, the exposed concrete was sprayed with Hunt-process clear curing compound.

On a span that was poured on Monday, 3,000-psi strength was reached on Wednesday—within 72 hours. This high early-strength concrete, achieved by using a rich mix and a low water-cement ratio (made possible by the addition of Plastiment), enabled the prestressing crew to start operations days earlier. The table of combined stresses (Table I) shows the effects of partial prestressing—with 8 of the 12 cables tensioned. The span can sustain its own weight in addition to a small construction load with low fiber stresses.

The end-blocks, cast a month earlier, had a minimum strength of 6,000 psi by the time the deck concrete had reached 3,000 psi for the first stage of stressing. The second-stage stressing was completed when the concrete had attained a strength of 4,000 psi. The jacking force of 128 kips for each cable against the 6,000-psi end-block avoided high jack concentration on the less strong girder ends. Because of cone slip and friction, an extra 20-kip jack load was needed. After cone seating, the force in the cable at the jacking end was 108 kips.

Two cables were stressed simultaneously with separate jacks at one end. The sequence of prestressing was arranged to minimize any transverse eccentricity of the section and vertical end eccentricities. The tensioning was done in two phases. Eight cables were tensioned first, and the remaining four

TABLE II. Stress in an interior girder before and after prestress losses

Fiber Stress	(1) P/A	(2) P_e/Z	(3) (1) + (2)	(4) M_{DL}/Z	(5) (3) + (4)	(6) M_{WS}/Z	(7) (5) + (6)	(8) M_{LL}/Z	(9) (7) + (8)
Initial:									
Top	....	....	− 720	+ 850	+ 130	+ 200	+ 330	+ 500	+ 830
Bottom	....	....	+ 4120	− 1790	+ 2330	− 430	+ 1900	− 1040	+ 860
Final:									
Top	+ 695	− 1295	− 600	+ 850	+ 250	+ 200	+ 450	+ 500	+ 950
Bottom	+ 695	+ 2740	+ 3435	− 1790	+ 1645	− 430	+ 1215	− 1040	+ 175

Note: Stresses are in psi. Plus stresses are compression. Nomenclature and data are as follows:

P = prestressing force
M_{WS} = moment (wearing surface) of 2-in. asphaltic concrete
M_{DL} = dead-load moment
M_{LL} = live-load moment
Z = section modulus
e = eccentricity
$e = 57.0 - 8 = 49.0$ in.
$P_e = 4{,}700$ kip-ft
$A = 1{,}657$ sq in.
$Z_T = 43{,}550$ in.^{3} (top)
$Z_B = 20{,}630$ in.^{3} (bottom

after the falsework was removed. Grouting of the flexible cable sheath was done on the fifth day. The median strip, curb and parapets were then concreted.

After the first phase of post-tensioning was accomplished, the falsework was lowered and moved to its next position. Since the bridge had much more stiffness than the falsework, the upward deflection from full tensioning amounted to only one-half as much as the downward deflection of the truss from the weight of concrete. Had the falsework not been released, the upward force from the elastic recovery of the truss would have overstressed and possibly cracked the deck. The trusses were fabricated with a 2-in. built-in camber and the forms were set for a 3-in. camber. After the deck was cast, a 1-in. camber remained.

Truss moved on barges

About five to six hours were usually needed to move the falsework to a new position. The trusses were lifted on two 30 x 105-ft steel deck-scows, fastened together. A jacking frame mounted on their decks consisted of two pairs of steel-sleeve guides which moved on reinforced 14-in. H-posts.

These frames lifted at the quarter points of the trusses. Two 60-ton jacks under each post raised or lowered the trusses in 12-in. increments, utilizing steel pins in holes on the posts. The jacks were powered by an air-driven hydraulic pump and could be individually controlled if necessary. The barge assembly included two air-driven winches (one two-drum and one three-drum), for positioning and moving the barges.

Beneath the end post of each truss, 5-ft hinged legs transmitted the concrete load through sand-jacks to three-legged steel bents supported on the base of the pier. These bents were fastened to the pier face by 1-in. Richmond "Tylags."

The procedure for removing the truss under a half span was, first, to release the 8 sand-jacks about 4 to 5 in.—after 8 of the 12 tensioning cables in each girder had been stressed. Then the jacking rig on the barge lifted the whole unit 2 or 3 in. Bolts that tied the hinged-leg joints to the face of the pier were removed and the legs swung inward and up—out of the way. Then the truss was lowered about 4½ ft, to just above the steel bents. This clearance permitted forms stacked on the truss to clear the girder bottoms. After unbolting, the steel bents were released from the piers and lifted about 6 in. by a pair of 3-ton come-alongs attached to the truss ends. The whole unit, bents and all, was then moved to the next location. There the procedure was reversed. The sand jacks were reloaded with sand and the unit positioned to about ½ in. above grade. Sufficient sand was later released to bring the form exactly to grade.

Design features

The design of a cast-in-place bridge of simple span is relatively straightforward. This is particularly so when the girder depth is ample, the web is rectangular, and primarily governed by the practical requirements of placing concrete and prestressing steel. A minimum web width of 12 in. was immediately adopted to facilitate field placing of concrete. In considering the placing of the post-tensioning tendons, it was found that a 12-in. web would give ample room without sacrificing the eccentricity of the tensioning force to any great extent. However, for another job all tendons would be put in two vertical rows to permit the use of larger vibrators. This bridge is basically similar to that designed by The Preload Co., Inc., for the Henry Avenue Bridge over Gorgas Lane in Philadelphia.

In the Hartford bridge, the entire basic cross-section is utilized for structural properties. In a T-beam section of this type, there is usually sufficient eccentricity of tendon steel to carry the structure's own weight. This means that the dead load can usually be ignored in the preliminary design.

If the concrete strength is assumed to be 4,500 psi (5,000-psi concrete was specified to obtain early strength) and the permissible concrete compression after all losses is a unit stress of 0.40 f'_c or 1,800 psi, then a section can be checked immediately for a given load condition. This is done by taking the superimposed dead load (load placed after post-tensioning) and the live load and checking to see if with these loads, the bottom fiber stress does not exceed 0.40 f'_c. If this is so, then the section is usually ample and the final design and investigation can proceed. The dead and live load stresses are shown in Table II.

Approaching this design a bit more theoretically, the stringer spacing can be determined, assuming a 12-in. web, and then the theoretically required depth can be found from the section modulus requirements based on the above stress criteria. However this does not necessarily give the most economical design. The spacing of the web is a function of the economy of the deck slab versus the web material. Often the detailed problem of conveniently placing and anchoring the commercially available tendons dictates the number of webs required. This does not result in the most economical arrangement but is a compromise to suit the small post-tensioning force per tendon available commercially.

As occurs quite often in prestressed concrete bridges of this type, the size requirements dictated by practical conditions determine the final member sizes. This is particularly so when the depth-span ratio is greater than 1/18.

The design criteria used for this bridge was the "Criteria for Prestressed Concrete" of the Bureau of Public Roads. The AASHO loading is H-20 S16-44. Losses due to volume changes and friction were as specified there. A stress table for the various stages of loading and time-dependent factors for an interior stringer are given in Table II. It should be noted that the change of stress on the bottom fiber due to live load is only 1,040 psi. This is a very favorable feature of prestressed concrete bridges.

The ultimate strength of this bridge based on a distribution factor of $S/5$ is 2.2 (dead load + live load), or looking at it another way, $1.0 \times$ dead load $+ 4.7 \times$ live load. The load factors shown above are governed by the stress at steel failure, which is typical for top-heavy T-sections of this type.

The Greater Hartford Bridge Authority is represented by William H. Putnam, Chairman; W. Burke Smith, Director; and Edwin B. Burdick, Chief Engineer. Gordon C. Linberg is Project Manager for the contractor, Merritt-Chapman & Scott. The over-all construction of the bridge was done under supervision of Burl A. Wilder, General Superintendent of the contractor's Hartford Division, with Gordon C. Linberg, Project Manager, and Clarence B. Sharp, Construction Design Consultant.

The Preload Co., Inc. of New York, is the contractor's Consultant on prestressing with M. Schupack, A.M. ASCE, Chief Engineer, responsible for the alternate design. They furnished the sketches for the bridges and developed the construction details that made the fast construction schedule possible.

DeLeuw, Cather & Brill, the New York consulting engineers, are serving as the General Consultant to the Authority with J. P. Purcell, J.M. ASCE, as Project Manager. Fred Simpson was the Resident Engineer; A. Morrell, Chief Structural Engineer; and J. A. Davidson, M. ASCE, Project Engineer. Thomas Worcester, A.M. ASCE, of Boston was the Authority's Design Engineer on this structure and J. Makaretz, their principal Structural Engineer. This firm prepared the original design and specifications as well as those for the alternate design.

LOREN W. OLMSTEAD, M. ASCE,

GERALD A. LYNDE,

FEEDER BEACHES

Summer storm of only moderate intensity overtopped sea wall and flooded road in neck section of Presque Isle Penninsula in August 1953. Erosion of this peninsula has been a problem for more than a hundred years. Peninsula is composed entirely of sand, and its narrow neck has been broken entirely through several times.

Unique in several respects is the Presque Isle shore protection project on Lake Erie at Erie, Pa. It is the first such project employing primarily beach nourishment to be constructed on the Great Lakes. It is the first cooperative federal-state beach erosion control project actually completed on the Great Lakes, and it is the first such project in which local interests, although paying two-thirds of the cost, turned construction responsibility over to the Corps of Engineers.

Probably its most remarkable feature is that it was carried out for about half the construction cost estimated in the authorizing project document. Maintenance costs are still to be determined before the works can be fully evaluated but this project may well mark the beginning of a new era in shore protection engineering technique on the Great Lakes. An article in CIVIL ENGINEERING for February 1951, by Col. Frank H. Forney, M. ASCE, and Gerald A. Lynde, recorded the long history (since 1836) of efforts to combat the erosive attacks of Lake Erie at this point, and presented the plans which have now been carried out to safeguard in a spectacular manner this 3,200-acre state park.

Several times since 1819, the date of the earliest reliable survey data, the narrow neck of the Presque Isle Peninsula has been entirely breached, and open water over a half mile wide has separated the end of the peninsula from the mainland. Although over $2,300,000 was spent by the Commonwealth of Pennsylvania and the Federal Government for various types of sea walls, bulkheads and groins, erosion of the lakeward perimeter of the peninsula continued and the structures required frequent repair and reinforce-

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and GROINS restore Presque Isle Peninsula

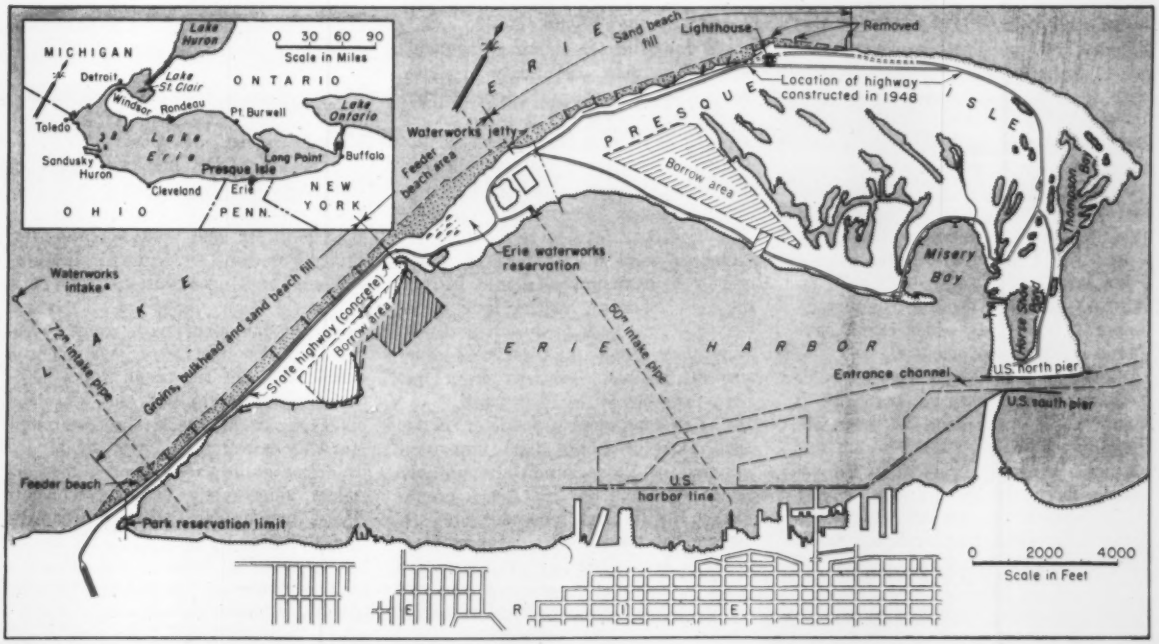
ment. The highway along the neck of the peninsula is the only access road to the park. Frequently during storms as much as a mile of it was inundated to a depth of one or two feet. Several short stretches of roadway were actually destroyed. This was the situation when the recently completed project for restoration and improvement of the peninsula was undertaken. At that time engineering studies of the problems involved had been under way for several years.

A study of the changes in the beach and bottom profiles in the intervals between surveys, and comparison with earlier surveys, definitely indicated that there was an over-all loss of sand from the shore end of the peninsula and a corresponding deposit at the easterly end. The annual demand rate of littoral drift was found to be some 25,000 cu yd. The rate of accretion at the most westerly of the two experimental groins, which during the first years following its construction in 1944 was capable of intercepting practically the entire natural supply of sand to the peninsula from the shore to the west, was found to be about 18,000 cu yd annually. Thus the studies proved that the natural supply of littoral material was not sufficient to meet the annual demand, and that groins alone could not be relied on to stabilize the shore.

In view of these conditions, the plan adopted for improving the neck section of the peninsula was designed to do two things: first, to supplement the natural supply of sand by artificial means, and second, to reduce the rate of future losses by the use of groins. The neck section is the most remote from prospective sources of artificial supply and at the same time is the most critical as regards danger to the one access road.

Restoration of the sand beach was considered a more suitable type of protection than the alternative of constructing higher and stronger bulkheads and sea walls. Two important considerations governed this choice.

FIG. 1. Beach erosion along Lake Erie side of Presque Isle Peninsula has been counteracted by pumping in about 4,200,000 cu yd of sand for regular and "feeder" beaches, plus construction of steel sheetpiling groins 300 ft long and 1,000 ft apart.



The bathing beaches of Presque Isle State Park are its principal attraction and therefore warrant attention and improvement. But an even more important consideration was the fact that whatever protection was provided had to insure that the highway through the neck section would be passable at all times to provide access to the principal picnic areas and beaches farther out on the peninsula. This was a requirement that existing works had not effectively met. Furthermore, even at the high unit cost then estimated for sand fill, it offered prospects of being more economical than defensive works of comparable effectiveness.

Spacing between groins was determined by observation of the effect of the two experimental groins constructed during the early stages of the study. The adopted spacing of 1,000 ft was considered the maximum possible at this location for groins 300 ft long and was chosen for the initial construction recognizing that experience would show whether intermediate groins to further reduce the rate of sand loss would prove economical. A total of 12 groins including the two earlier experimental groins were provided in the authorized plan, all located in the western third of the problem area. See Fig. 1. If the beach ever becomes totally depleted in the intervals between periodic replenishment, a continuous bulkhead completely buried under the initial beach fill, will provide emergency protection for the highway and allow time for replacement of sand before the highway can be seriously damaged.

Beyond the neck section of the peninsula, the plan provides only for restoration and improvement of the beaches by artificial placement of sand, with a feeder beach at the western end, where the groin system terminates, to nourish shores to the east. No groins or bulkheads in addition to those already in place (which are almost completely covered by beach fill) are included in the plan of improvement for this area. One groin (near the Lighthouse), which would have interfered with free littoral passage of sand, was shortened, and remnants of bulkheads, which might have induced scour, were removed.

Basically the design beach profile consists of a horizontal berm 60 ft wide, a slope of 1 on 20 from the berm crest to low-water datum, and thence a slope of 1 on 40 to the toe of the fill at the natural lake bottom. This berm width was chosen to provide a desirable bathing-beach width and reasonable insurance against depletion of the beach at any one point by temporary losses or changes in alignment. The beach slopes approximate the natural beach slopes at the distal end of the peninsula.

The required berm height of the beach fill was determined from observation of the heights of existing natural beach berms on the peninsula. These varied from 7 to 12 ft above low-water datum. Supplementary laboratory experiments of the Beach Erosion Board determined the extent of run-up on the design slope by storm waves. A berm elevation of 10 ft above low-water datum was adopted for the neck section where protection of the highway is of vital concern, as this elevation will prevent practically all overtopping of the beach except possibly during the most severe storms. Just adjacent to the neck section the berm height was reduced to 9 ft for the next 3,000 ft of beach and then further reduced to 8 ft for the remainder of the fill to the east.

To provide a surplus of sand to offset the accelerated rate of depletion that may occur during the first few years of adjustment and stabilization of the beach fill, a "feeder beach" was built up at the westerly or updrift end of the neck section. A second feeder beach was placed next to and just downdrift of the most easterly groin. These feeder beaches were provided by widening the beach berm an additional 100 ft for a length of about 850 ft in the first instance and for about 1,900 ft in the second. These feeder beaches, shown in Fig. 1, contain approximately 100,000 and 150,000 cu yd of sand respectively, estimated to be enough to offset losses during the first five years of the life of the project at an erosion rate expected to be about double that looked for after the initial adjustment period. The plan accordingly provides for replenishment of the feeder beaches in five years and at estimated intervals of 10 years thereafter.

Since placement of the sand fill was the primary feature and the major item of cost in the project, considerable effort was devoted to determining sources of sand and methods of placement for maximum economy. During the early planning, existing beaches on the peninsula were analyzed to determine their slopes and the sand-grain size at various elevations from the berm crest out to the 18-ft depth.

The average median diameter of the sand samples—about 0.20 mm—was adopted as the criterion for suitable beach fill. Since the final beach profile (after the fill has been subjected to systematic wave forces over a long period) is a function of wave and sand characteristics, sand of this size could be expected to assume the same slope as the sampled beach profiles in the same wave climate. Consequently the beach profiles adopted for estimating the quantity of beach fill, had the same slopes as the existing natural beaches. This led to the adoption of an equilibrium slope of 1 on 20 from the berm crest to low-water datum (about 2 ft below mean lake level) and 1 on 40 from that point to the toe of the beach fill.

In the final planning stage, efforts were concentrated on finding the most economical source and method of placing for the sand fill. The estimated quantity required was 4,200,000 cu yd. Valuable advice and technical assistance in this investigation were furnished by the staff of the Beach Erosion Board.

Since the very fine material of the bay bottom had been found unacceptable, the only remaining nearby source was the peninsula itself. Exploratory core samples were taken in the bulge on the bay side of the neck and around the edges of the most westerly pond just lakeward of the neck section. All points on the proposed beach were within direct pumping range of at least one of the selected borrow areas (Fig. 1).

In general the sand became progressively finer with depth, and over 10 ft below low-water datum it was too fine to meet the specifications. Sufficient sand for the initial beach fill and a reserve thought adequate for 50 years of maintenance was located.

Plans and specifications for the sand fill were completed in July 1955, by which time sufficient federal funds had been appropriated to cover the estimated federal share of the construction costs for the ensuing year. Pennsylvania funds covering two-thirds of the estimated cost of the entire project had already been appropriated. Bids for placement of the sand fill were opened on August 16, 1955. In the meantime plans were being completed for constructing groins in the neck section. The sand fill was placed under one contract and the groins were constructed under another.

Plans and specifications for both contracts were aimed at maximum economy consistent with sound engineering. The contractor was not required to grade the beach slopes lakeward of the berm but only to place in each 100-ft reach the computed quantity required to bring the fill up to design grade based on cross sections taken immediately before placement. Wave action was depended upon to move the sand out to form the toe of the underwater slope.

The Atlantic, Gulf and Pacific

Dredge "Baltimore", brought all the way from Florida via Mississippi River, pumps hourly average of 1,400 cu yd with average discharge pipe length of 5,960 ft. Note dredge in borrow area at upper right, and two branches of 27-in. pipe discharging in foreground. Fine beach of white sand is the result, as seen at right. Note groins, also feeder beach at upper end of this air view.

Company of New York, N. Y., was awarded the contract for placing the sand fill required. Its hydraulic dredge *Baltimore*, which was in West Palm Beach, Fla., when the contract was awarded, was brought to Erie by way of the Gulf Coast, the Mississippi River, and the Illinois Waterway into Lake Michigan at Chicago. The dredge left West Palm Beach on September 5, 1955 and arrived in Erie on October 10, traveling a total of about 2,750 miles in 45 days. It started work on November 8, and pumped approximately 837,000 cu yd of sand to the beach area before winter weather stopped operations on December 18, 1955. The specifications required placement of 2,000 lin ft of the beach before that date in a section where a short stretch of bulkhead and highway had been destroyed the previous spring. The quantity placed more than met the requirements. Winter work was not possible because of ice in the beach area. Work was resumed on April 26, and completed on August 24, 1956. In the 20 months since its completion the restored beach has demonstrated its adequacy in providing the protection sought.

The dredge *Baltimore*, built by the Ellicott Machine Corp., is powered by oil-fired steam turbines of 4,000-hp capacity. It has a 34-in. intake line and 27-in. discharge. Its average hourly output for the entire job was 1,420 cu yd with an average discharge pipe length of 5,960 ft. No boosters were used in the discharge line. With the maximum length of discharge pipe —9,072 ft on this work—the pumping rate was reduced to 1,100 cu yd per hr.

No unusual difficulties were experienced. A bulldozer was in constant use on the beach to build temporary sand dikes and shape the berm and back slope where necessary. A "Y" near the discharge end of the line provided for parallel gated discharge pipes to regulate the width of the beach berm and permit uninterrupted pumping while alternate pipes were being shifted and lengthened. The only other pieces of attendant plant were a small tug, an oil scow, a water scow, and a derrick boat of 10-ton capacity, used primarily for handling anchors.

The unit price for placing the sand fill was $0.3274 per cu yd, and the Atlantic, Gulf and Pacific Co. was paid for placing 4,149,427 cu yd.

Placement of fill in the neck section was followed closely by groin construction. The contract for the ten new groins, alteration of two existing groins, and removal of a badly damaged bulkhead section near the easterly end of the project was awarded to the L. A. Wells Construction Co. of Cleveland, Ohio, in the late fall of 1955. Some work was done during the winter on removal of bulkheads but the ten new groins were all built during the summer of 1956. All are of steel sheetpiling. The two westerly groins are of gravity-type cellular construction, stone filled and concrete capped because of the presence of shale close to the surface. The rest consist of a single row of steel sheetpiling of cantilever design.

Payment to the contractor for the cellular groins averaged about $84,600 each; for the cantilever groins, about $27,000 each.

The total cost of the entire cooperative project was $2,451,269.48, which includes a stone sea wall 3,000 ft long built in 1952 in the neck section in addition to the sand fill and groin construction described in detail here. Two thirds of the total cost of the project, or $1,634,179.65, was borne by the Commonwealth of Pennsylvania. The remaining $817,089.83 was the U.S. Government's share. The cost estimate for the entire project on which federal authorization (in 1954) was based was $6,018,000. The very large saving in cost was made possible by the thorough investigation of material sources, careful planning of construction sequence, and the wholehearted cooperation of all the agencies concerned—federal, state and local.

(This article is based on the paper presented by the writers at the ASCE Buffalo Convention in June 1957, before a joint session of the Waterways and Harbors and Hydraulics Divisions. This session, under the auspices of the former Division's Committee on Navigation and Flood Control Facilities, was presided over by Roger H. Gilman, a member of this Division's Executive Committee.)

The Architectus of the Roman Empire—Part 5

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A late Roman construction development is exemplified by Aqueduct of Caesarea, in Algeria, which probably dates from Hadrian's reign. Instead of massive arches in horizontal tiers, seen on earlier Pont du Gard, this aqueduct has high, narrow piers braced by thin jack arches. Piers are of concrete, faced with stone below and brick above. After Gsell.

Trials of a Roman engineer and tunnel builder some eighteen hundred years ago are vividly related on monument of Nonius Datus, probably his tombstone. His problems included two headings that failed to meet on a water supply tunnel for city of Saldae (now Bougie) in North Africa.

In writing of the remarkable man who followed Trajan as emperor, Rivoira states (in *Roman Architecture*, translation published by Clarendon Press, Oxford, 1925):

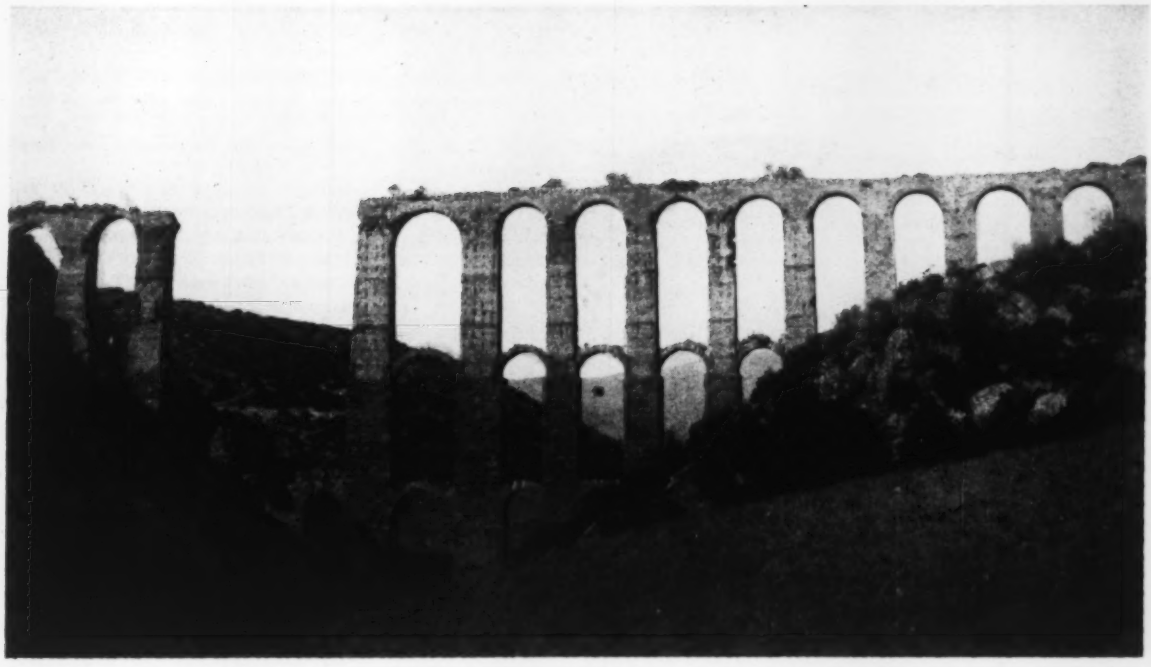
"The accession of Hadrian was followed by a rapid and notable advance in Roman construction; so much so that the 20-odd years of his brilliant reign (117-138 A.D.) were among the most important in architecture. . . . And this was due to the direct activity of this versatile emperor. We learn from the ancient writers that Hadrian, among his many intellectual qualifications, possessed to an eminent degree those which are indispensable to a master builder—a sound knowledge of mathematics, geometry, and drawing."

To this should be added a keen sense of structural possibilities and requirements for, while there is no proof that Hadrian actually provided the plans for all the numerous works he sponsored, we are told that those in Rome were his own creations. It is related, for example, that he sent Apollodorus his own designs for the temple of Venus, to prove to this opinionated Greek *architectus* that important buildings could be planned without his aid. While, therefore, one Decrianus is credited with being Hadrian's engineer-architect in charge of construction, Hadrian himself can be truly designated as both a brilliant emperor and a competent *architectus*.

The two most famous of Hadrian's buildings in Rome are his tomb, now known as the Castel Sant'Angelo, and the even more famous domed structure, the Pantheon. In addition to these two major structures, there are several other works which have special interest for the engineer.

To provide access to the huge cylindrical pile that was to be his tomb—since it was on the opposite side of the Tiber from the main city—Trajan built a famous bridge in 136 A.D. This structure, the Pons Aelius, better known today as the Ponte Sant'Angelo, still remains in substantially its original condition. The same cannot be said of his tomb which became a fortress in 403 and was so used through the Middle Ages. Only the core now remains, stripped of its marble facing.

Although it maintains the standard form of earlier Roman bridges, the Pons Aelius reflects the splendor of imperial Rome in the elaborateness of its architectural detail. It is thus in sharp contrast to the rugged simplicity of such bridges as that of Lacer at Alcantara or the massive structure at Narni. The parapet walls failed in a panic in 1450 and were replaced by an open railing, a decidedly un-Roman feature. In 1892, when only six arches were in evidence between the embank-



ments, excavations revealed two more on the left bank and uncovered the steep approach incline 130 ft long (11 percent) which had originally been required to reach the bridge from the lower bank level of ancient times. It is assumed that originally there was an additional arch and a similar incline on the right bank. This would bring the original number of spans to nine, an unequal number being considered desirable to balance the work esthetically about an axis through a central opening.

As for Hadrian's second great building in Rome, the Pantheon, it bears the name of Agrippa although it was undoubtedly an achievement of Hadrian's reign. Agrippa's original structure was destroyed in the great fire of Nero's reign in 80 A.D., and its successor likewise was destroyed by a fire—this one caused by lightning in 110 A.D. Hadrian's Pantheon is one of the world's great structures. Its huge dome, over 140 ft in diameter, with a 28-ft circular opening at the top, rests on a massive circular drum. Forerunner of later domed buildings, the Pantheon is awe inspiring in its height (140 ft) and scale.

As a structural *tour de force* it has been the subject of much discussion. On the one hand it has been characterized as a cave quarried out of a solid mass of concrete, on the other, as an architectural marvel, exemplifying the peak of Roman development in building construction. Its shell is a curious combination of brick and tile ribs and arched cross-ribs filled with a concrete of lighter weight. Rivoira regards it as the master effort of a great structural genius, Hadrian himself. The thrust of the single, full centered, deeply coffered dome is carried by the heavy walls of the drum, which are 20 ft thick. Stripped of its marble facing and supposed bronze roof tile, it still stands in impressive grandeur after 18 centuries of abuse.

One of its most original and most extraordinary features has completely disappeared. A bronze roof truss, a remarkable anticipation of modern structural design and fabrication (it was riveted), once supported the roof of the entrance portico. Its estimated 200 tons of bronze survived earlier vandals but proved too much of a temptation for the later Church. It was melted down and cast into cannon by Pope Urban VIII in 1625. Renaissance artists have left us sketches showing its general form—a metal roof truss built 1,600 years before the dawn of the age of metal in construction.

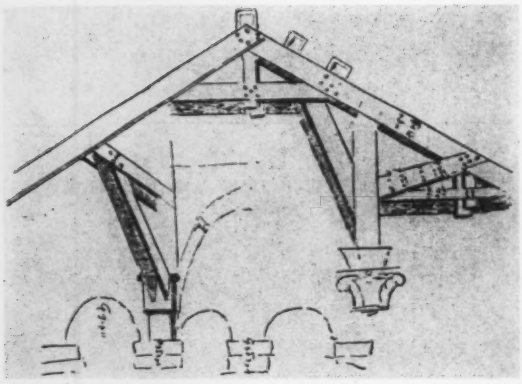
Hadrian, like his foster-father Trajan, was born in Spain and undoubtedly sponsored a number of Spanish works. A three-level aqueduct at Mérida may belong to his reign rather than to Trajan's. Italia had its Tejada Aqueduct, some 25 miles long, to supply the Roman Baths there, and Sagunto once had an aqueduct as well as a theater, circus, bridge, and fort. But as a later Spanish poet noted:

> **"With marbles of noble inscriptions**
> **From Roman theaters and altars**
> **They now build taverns and pot-houses**
> **In the ancient city of Saguntum."**

Toledo, Cordoba, Gades and many other cities of this ancient Roman province also possess ruins, but Spain is not unique in this respect. Hadrian made a tour of the empire in 119 A.D. and works sponsored by him are scattered widely. His famous wall in Britain is matched by that joining the Rhine and Danube, the northern boundary of the Empire. Then there is his aqueduct at Athens, besides works of outstanding interest in North Africa dating from this same period.

No less than 22 "principal" aqueducts in Algeria have been listed. That of Carthage, with all its turns and windings, is said to have been 80 miles long. Its upper section, a side-hill canal, was used in 1862 by French engineers for the water supply of Tunis, while the ruins of an arched section "stretch across the plain like the bleached vertebra of some gigantic serpent."

In these works, as in the aqueduct at Mérida, a new type of arch design



First metal roof truss, for portico of Hadrian's Pantheon, dates from around 125 A.D. This 200-ton riveted bronze truss was melted up for cannon by Pope Urban VIII in 1625, but some idea of its form is revealed by early sketches such as this by Dosio.

appears. The superimposed tiers of arches found in the Pont du Gard and the Aqueduct of Segovia are replaced by tall piers arched over at the top and braced by lower jack arches. This form is well illustrated in the aqueduct of Cherchel, 115 ft high. Here the tall piers, built with a concrete core, are in part faced with cut stone and in part with brick.

Nonius Datus and the Tunnel of Saldae

Another of the rare survivals from ancient times, actually from this same period, throws an interesting sidelight on the trials of the engineer of the day. A small monument of hexagonal form, dated 152 A.D., was found at Lambese, Algeria, in 1866. It appears to have been the tombstone of one Nonius Datus, "a veteran of the Third Augustan Legion," and a tunnel surveyor and expert. Although the inscriptions on only three sides have survived (see *Corpus Inscriptiorum*, Vol, III, No. 2728), the missing parts of the story are readily surmised.

The water supply of Saldae (now Bougie) was drawn from the Toudja about 13 miles from the city, requiring both an aqueduct and a tunnel some 1,400 ft long. Nonius Datus surveyed the line about 137 A.D., and the work was started about 148 A.D. according to his instructions. He notes that he made the tunnel survey by "ranging in" a line over the mountain.

"The alignment was marked off with stakes over the mountain from east to west. Lest there should be any error made about the headings . . . the upper heading is the place where the tunnel receives the water, and the lower heading is where it flows out. When I had assigned the workers, so that they might each of them know the digging he was to do, I instituted a contest between the marines and the troops from Gaul."

Four years later, Datus was sent for in haste by Valerius Clemens, the procurator or manager of finances of the area. On the way, Datus relates, he was set upon by thieves who stole even his clothing. He continues:

"When I reached Saldae the procurator took me to the mountain where they were weeping over the tunnel which appeared to be of doubtful value. It was thought it would have to be abandoned because the digging through of the work of the tunnel had already reached a length which was greater than the distance through the mountain. It appeared that there had been a mistake in the headings in such a way that the upper heading goes to the right hand, that is to the south, and the lower also to the right, that is north, and the two parts were wrong, not being in line with each other."

Lanciani (*The Ruins of Rome*, Boston, 1897) remarks that Datus seems to have taken all necessary precautions, but as usual the blame was put on the engineer, and if he had not been sent for, Saldae might have had two tunnels instead of one. Presumably Datus joined the headings with a cross cut, as Eupalinus had done in his pioneer work at Samis some 700 years earlier, for Datus goes on to record:

"Thus I finished the work, and when it was finished and the water passed through, it was dedicated by Valerius Clemens."

Inverted siphons

A few remains of inverted siphons dating back to Roman times have been discovered. These reveal, as would be expected, the limitations imposed by the materials available, but they also show that the Roman engineer had achieved at least some understanding of the problems involved in planning pressure pipelines. No names of engineers directly responsible for works of this type have come down to us.

Many remains of Roman lead pipe have survived. This pipe was formed by bending sheet lead into oval form and soldering the longitudinal joint. It was extensively used in Rome for the "private supplies" which so annoyed Frontinus. It was also used for a few inverted siphons. It was standard Roman practice to support the larger aqueduct lines "at grade" on masonry arches, but on several aqueducts, valleys were crossed by using so-called "inverted siphons," a type of construction mentioned by Vitruvius—whose description is exasperatingly obscure. The remains of those that have been found appear to include one or two larger lines in Rome as well as interesting ruins at Aspendus in Asia Minor. The most revealing ruins are those of the so-called Aqueduct du Gier, one of four water lines at Lyons in France.

Only scattered droppings formed when the lead was stolen and melted remain to show the location of the lead pipes which originally made up this crossing. The general plan seems clear—a combination of arched viaduct and pressure-pipe construction. On low arches the water was carried a certain distance into the valley on each side at grade, to a massive pier. Each pier contained a narrow reservoir chamber about 20 ft wide and 7 ft long, and the two reservoirs were connected by lead pipelines, ten in number, running across the lower valley. The pipes, which had a diameter of 8⅔ in., were spaced about 2 ft apart on centers. They were carried down an arched ramp and across the lowest part of the valley on arches to join similar structures on the far side. Three other siphons on the line appear to have been of the same type. Heads varied from 154 to 403 ft.

It is evident that this plan reduced both the length of the pipes required and the maximum head to which they were subjected, presumably with the aim of achieving a favorable balance in cost between arched viaduct and piping. While the use of the ten smaller pipes may have been dictated by the difficulty of making pipe in larger sizes, it also may indicate that the builders realized the limitations of lead pipe under pressure, and understood that bursting pressure increases with pipe size.

The fact that metal always offered a temptation to thieves may have discouraged a wider use of this form of construction. Furthermore, such undertakings were not always successful. This is noted by Lanciani, who

describes a similar work in Rome of about 90 A.D., which was later replaced by the usual aqueduct carried at grade on arches. Only the discovery centuries later of a stronger and not too costly metal made syphon construction practicable.

Decline and fall

Following Hadrian came his adopted son, Antonius Pius, from 138 to 161 A.D., under whom some of the most important works begun by Hadrian were completed. Pius, in turn, was followed by the brilliant soldier-philosopher, Marcus Aurelius (161-180), but the great period of Roman engineering was over. In the century following Aurelius, over eighty weak and incompetent emperors were set up and cut down by the army. There was a brief period of reorganization under Aurelian and Diocletian, but the Roman empire had reached its greatest power and extent under Hadrian. In 330 Constantine, who ruled from 324 to 337, moved the center of government from Rome to the ancient Greek town of Byzantium on the Bosphorus. There the Eastern Empire continued for a thousand years—until conquered by the Turks in 1453. After Constantine, the Western Empire continued to decline. Rome was taken by the Goths in 410, by the Vandals in 455, and the long period known as the Dark or Middle Ages was ushered in.

Various points of view have been expressed by historians attempting to explain the decline and fall of the Roman Empire. Rome failed not only to bring unity to Western Europe—a unity which is still to be achieved—but also to provide a competent and stable government at home. Economic difficulties, oppressive taxes, corrupt government—all these factors and others contributed to the collapse of the high standard of living which was widely enjoyed under the Empire and which was not to be equaled again for a thousand years. Perhaps, as Dean Gauss of Princeton has suggested, only the transportation and industrial facilities provided by modern engineering could have avoided this collapse—facilities of which the Roman never dreamed.

Yet Rome's engineering achievements were hardly surpassed until the nineteenth century, as even this brief sampling of her widespread and varied activities has shown. Four basic factors have long influenced engineering progress—consumer demand, availability of materials, power resources, and technical understanding.

Most important of these is a healthy, widespread and continuing demand resting on a sound economy and a stable and progressive government. This Rome provided until its later years.

Pantheon, built about 125 A.D., was a major structural achievement of Roman times. Its hemispherical dome, 144 ft in diameter, is supported on walls 20 ft thick. Light comes through central opening of 28-ft diameter in dome.

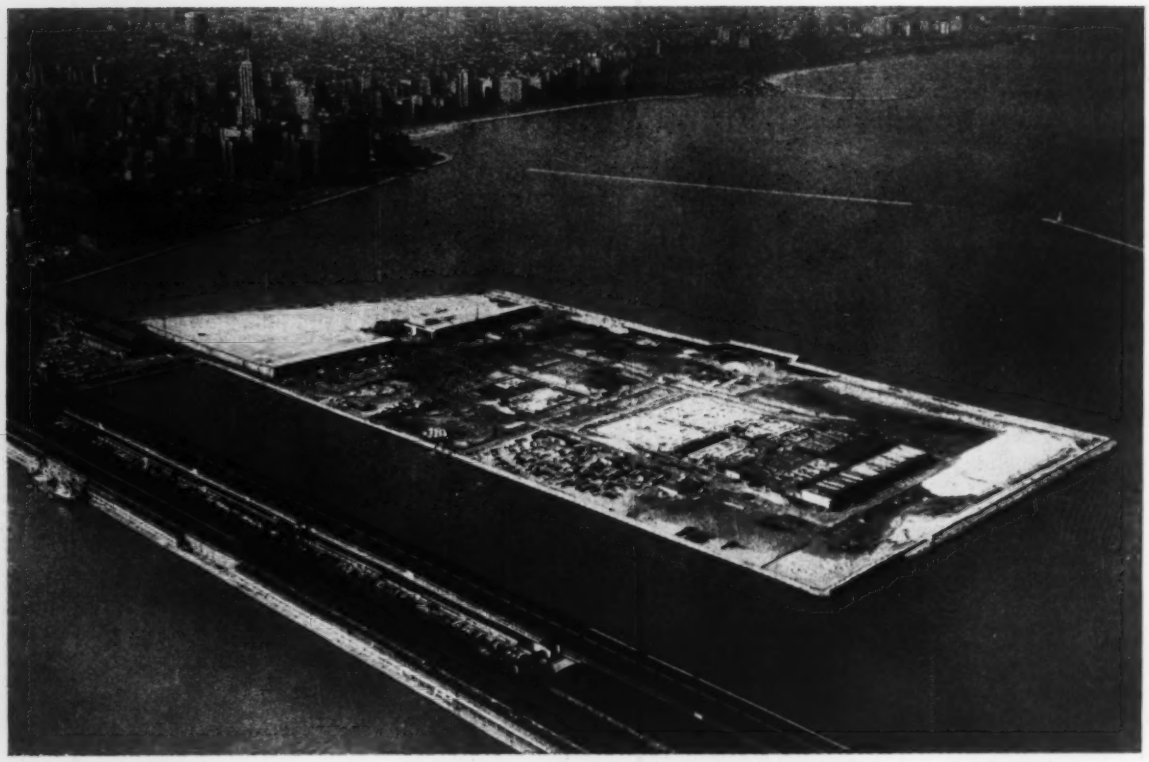
Availability of materials also has played a large part in the character and scope of engineering works. The Roman builder was limited to timber, stone, brick, and a hydraulic cement formed by combining volcanic pozzuolana ash with lime. Until the late eighteenth century in Britain the engineer everywhere faced these same limitations.

In power resources, the Roman engineer also was limited largely to manpower aided by such simple mechanical advantages as the lever, wheel, pulley, inclined plane and wedge. Oxen were sometimes used but the horse did not become a draft animal until some centuries later.

Finally, it is clear that the Roman engineer could and did accomplish much with a very meager technical understanding. While engineering science was to grow slowly through later centuries, it was not until the mid-nineteenth century that its potentialities came to be recognized. In earlier days, factors other than exact quantitative understandings controlled. In fact it is doubtful whether modern structural mechanics would have aided the Roman bridge builder to any great extent. Even today, as a recent authority on the arch puts it, "On fait une voute d'apres les voutes faites; c'est affaire d'experience." (An arch is made like other arches that have been made; it is a matter of experience.)

It would seem probable that local conditions exerted considerable influence on the character of individual Roman works. Thus, at a time when concrete and brick with stone facing were widely used in Rome, many provincial structures were built entirely of cut stone. Pozzuolana for cement was available only in Italy, transportation was difficult except by water, and labor was presumably plentiful. In short the Roman builder, whatever his preferences as to the materials for his structure, was quick to make the best use of local resources in materials and skills.

The Grecophile is inclined to remark, "If you see an outstanding Roman work in cut stone, you can be sure a Greek did it." There can be no doubt that Rome owed much to Greece not only for basic techniques of surveying, planning and construction, but also for handwork and tool skills. In spite of the fact that highly skilled workers on Roman projects may have been Greeks or taught by Greeks, it was their Roman masters who recognized and utilized their skills. Furthermore it was the Romans who adapted these skills to the needs of an empire which had no parallel until the rise of the British Empire in the nineteenth century.



Chicago's Central District Filtration Plant will supply water to three million people when completed in 1961. Cost will be about $90,000,000. Substructure contracts are now under way. Chicago's famed Navy Pier is in foreground.

World's largest filtration

Chicago's Central District Filtration Plant, when completed about four years from now, will be by far the world's largest municipal water filtration plant. Based on the usual filter rating of 2 gal per sq ft per min, it will have a capacity of 960 mgd (million gallons per day). Its actual capacity will be considerably more, as it is being designed hydraulically so that it can treat 1,680 mgd.

The plant will provide filtered water to about three million people residing in the northern two-thirds of Chicago and its adjacent suburbs. Its estimated cost (including the connecting tunnels) is approximately $90,000,000. In conjunction with the South District Filtration Plant, crystal clear filtered water will be provided to the more than 4,600,000 people residing in the Chicago area.

The proper location for the filtration plant was determined after extensive studies by the city's consultants and its engineering staff. The site is on the edge of Lake Michigan 400 ft north of the Navy Pier and just offshore from the northern edge of the Loop. Earlier studies had indicated that it might be desirable to provide separate filtration plants for the Central Water District and the North Water District (Fig. 1), but when detailed estimates were made of construction and operation costs, it was found that considerable economies would result from a single plant. Although the construction costs of two plants would be less, the overall costs, including interest and amortization of construction costs, were about $140,000 a year less for the single plant.

A single plant at the Central District site has various other advantages. It will be within the protection of the existing Federal Government breakwater; it will be close to the existing tunnels from the Dever and Carter Harrison cribs, from which the raw lake water would normally be taken; a direct lake intake will be provided to the low-lift pumps; bulk chemicals can be delivered by barge; and connection can be made quite easily to the existing railroad tracks in the vicinity, thus providing another means for delivery of chemicals and other operating supplies.

There are three major divisions of work—preparation of the site, construction of connecting tunnels, and building of the plant structures.

World's largest cofferdam

To prepare the site, about 61 acres of Lake Michigan were dewatered inside cofferdam walls having a total length of 6,480 ft. As far as we have

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FIG. 1. Filtered-water tunnel 27,600 ft long will enable Chicago's Central District Filtration Plant to supply North District also.

plant

Below: Part of filter substructure contract was clear well, here seen completed.

been able to determine, this is the largest cofferdam ever built. Walls of the cofferdam are of two types (Fig. 2). Major parts of the west, north, and east sides are of dike-type construction. The dike is an impervious clay core faced with small stone on the inside and large stone on the lake side. Large pieces of Bedford limestone are used above the water level on the outside face to provide a durable and pleasing structure that is part of the permanent installation. The steel sheetpile cellular type of construction was used for the entire length of the south wall, a part of the east wall, and the center section of the north wall.

The sheetpile cellular construction was selected for the south wall to provide an unobstructed slip between the filtration plant and the Navy Pier. Large ships can thus use the

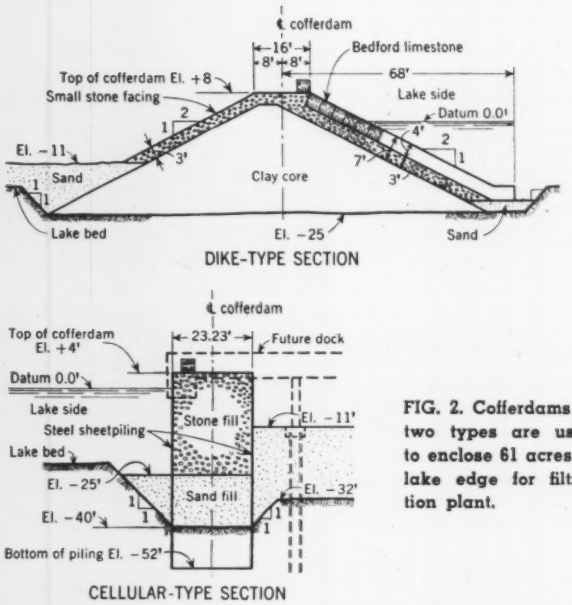


FIG. 2. Cofferdams of two types are used to enclose 61 acres of lake edge for filtration plant.

protected north side of the Navy Pier or can deliver materials to the plant. This type of construction will also accommodate railroad tracks along the south side of the plant for delivery of chemicals and other operating supplies.

To permit construction of a direct lake intake to the low-lift pumping station, the center part of the north cofferdam wall was offset. After the pumping station is constructed and connections are made from this structure to the cofferdam, the offset portion will be removed. Cellular construction was used here because it can be more easily removed than the dike type.

The cofferdam contract included extensive excavation of soft material over most of the site area, and the placing of about one million cubic yards of sand fill to bring the bed of the lake up to the under side of the structures being built within the cofferdam. The cofferdam contract amounted to $6,597,510. Work began in 1952 and was completed in 1955.

Connecting tunnels

Tunnel work includes the construction of a new raw-water tunnel (bringing water to the plant) and two filtered-water tunnels (taking water from the plant). The general layout of these tunnels at the plant is shown in Fig. 3.

The new raw-water tunnel of 20-ft diameter connects the filtration plant with the existing intake tunnel from Dever Crib. By reactivating the unused 10-ft-diameter tunnel from the Carter Harrison Crib, lake water will be routed, as shown in Fig. 1, from both existing cribs to the new filtration plant.

The two filtered-water tunnels extend northwesterly from a pair of vertical shafts under the filtered-water reservoir. One is a 16-ft horseshoe-shaped tunnel connecting the north shaft to the Wilson Avenue tunnel system. The other is a similar 16-ft tunnel connecting the south shaft to the Chicago Avenue tunnel system.

These tunnels have a total length of about six miles. Practically all the tunnel work is in rock at depths of from 130 to 240 ft below the level of Lake Michigan. All tunnels will be lined with concrete. A contract for all the tunnel work—except for the actual connections to existing tunnels—was let in 1955 for $12,696,640. This work is now about 70 percent completed. Innovations in drilling and blasting that have speeded the tunnel work are described in two accompanying articles.

Work on the filtration-plant structures is divided into a number of contracts. The general arrangement and extent of these structures is shown in Fig. 3.

The filtered-water reservoir, with a capacity of 68 million gal, was the first of these structures to be built. The contract, for $3,918,582, was let on January 16, 1956. Work began early in 1956 and was practically completed by the end of 1957. Some 19,000 timber piles support units containing 47,000 cu yd of concrete and 8,400,000 lb of reinforcing steel.

The filter substructure is in two units, each having forty-eight 10-mgd filters, or a total of 96 filters. Combined filter capacity, rated at the usual 2 gal per sq ft per min, is 960 mgd. Work began on this contract in April 1957 and it is now about half completed. The filter substructures are of the two-level type with the filter boxes above and the clear wells below. The clear wells will have a total capacity of 60 million gal of filtered water. The filters are of the dual type with a center wash-water gullet, but each half of the filter has a separate manifold below the floor.

Plans and specifications are now being prepared for the settling basins, including the slow-mix channels, which are of the around-the-end type. Each of the four channels will have mixers of the paddle type with provisions for varying the speed of rotation as desired. The basins are of the two-level type, with scrapers to be installed initially on the upper level only. Provisions will be made so that scrapers can be installed on the lower level later if desired. It is estimated that these settling basins will cost about $13,000,000.

Plans and specifications for the headhouse substructure are at present being prepared by the consulting architect-engineers. Included within the headhouse area are the low-lift and wash-water pumps, the electrical substation, boiler plant, chemical building, offices, shops, wash-water tanks, and auxiliary equipment.

Superstructure work will be divided into two contracts. General studies for the architectural treatment of the whole plant are now being made by architect-engineers retained by the city. The architectural treatment of the plant will be in conformity with the adjacent near north-side area. The city's consultants will prepare the plans and specifications for the superstructures in the headhouse area but the city's engineers and architects will prepare the plans for the two filter superstructures.

Contracts for operating equipment

A number of contracts will be let for plant operating equipment. The major ones now contemplated include those for low-lift pumps, filter equipment, wash-water pumps, butterfly valves, piping, sediment removal and flocculating equipment, and electrical equipment. A contract has been awarded for six low-lift pumps at 260 mgd (400 cfs) and two at 170 mgd (260 cfs) at $1,503,000; also a contract for 313 butterfly valves, ranging in size from 42 to 84 in., at $1,039,190. It is estimated that 1,000 butterfly valves

will be required for the project. A separate contract was awarded for the 313 valves to spread the work over a longer period. The manufacture of 1,000 valves would tax the capacity of the largest valve manufacturer for two years.

A $3,186,890 contract includes the furnishing of filter underdrains, washwater troughs and sand and gravel. Alternate bids were taken on three typs of underdrains—cast-iron laterals, Wheeler and Leopold bottoms—and the low bid was for the cast-iron lateral type. The major contract items include about 60 miles of 4-in. cast-iron pipe, 2,304 wash-water troughs each 25 ft long, 27,100 cu yd of sand, and 19,200 cu yd of gravel.

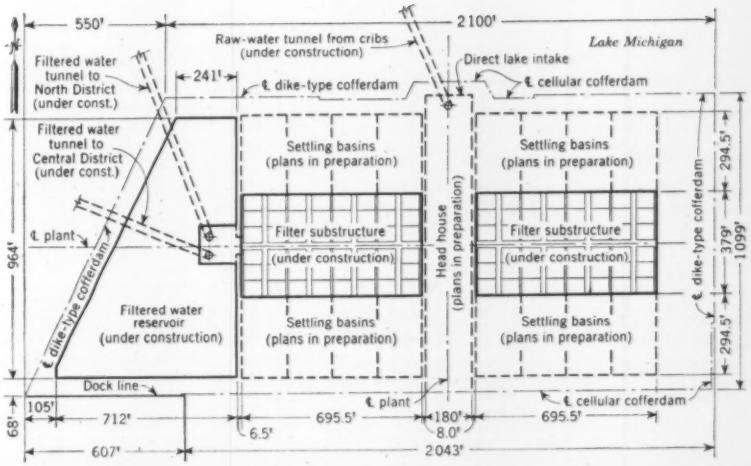


FIG. 3. Layout of filtration plant gives status of major parts of the work. Headhouse will include Low-Lift Pumping Station at north end, and Chemical and Administration Buildings at south end.

Plant operation

This plant, of the rapid sand filtration type, is operated essentially as shown in Fig. 4. During normal plant operation, water will be taken from Lake Michigan through the Dever and Carter Harrison intake cribs and via the connecting tunnels of 16, 10 and 20-ft diameter to the low-lift pump intakes. The six 260-mgd and the two 170-mgd pumps will elevate the water 25.5 ft to the pump discharge channels. From them it will flow into conduits passing below the chemical building, where chemicals will be added. These will include alum (aluminum sulphate) or a combination of ferrous sulphate and chlorine, to coagulate the suspended solids in the water; activated carbon, to remove objectionable tastes and odors; lime, to lessen corrosion in the distribution system; ammonium sulphate, to prevent chlorinous tastes; and fluoride, to lessen dental caries. Chlorine is applied at various points to make the water bacteriologically safe.

Next the water flows to the mixing basins where the chemicals are thoroughly mixed in and a floc is formed by interaction between the chemicals and the suspended solids. The water then flows into the settling basins where the floc settles and is removed in the form of sludge. This is removed continuously or intermittently depending on quantity. Water from the basins flows to the filters, where the remaining impurities are removed.

The filter media consists of 26 in. of uniformly graded sand, about 20 in. of gravel with a 4-in. cast-iron underdrain system. The filtered water passes through regulating and measuring devices to the clear wells under the filters and thence to the filtered-water reservoir and the distribution system.

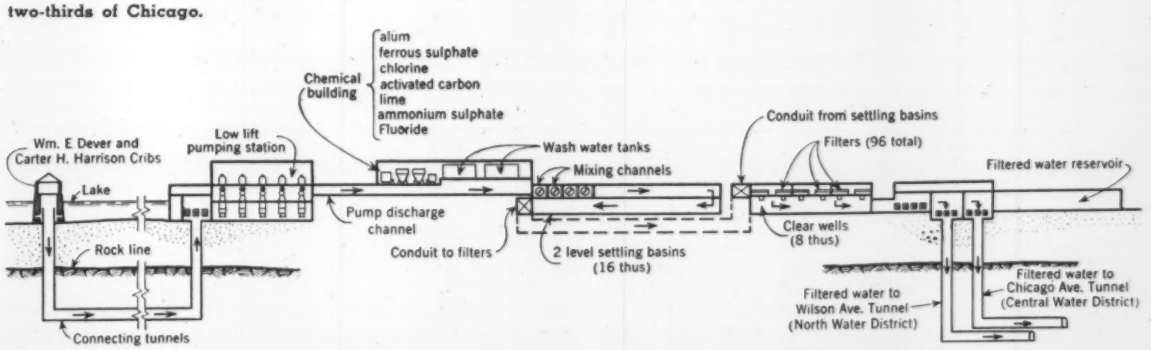
An essential part of the filtering process is the periodic removal of material that accumulates on the filter sand and gradually reduces its efficiency. This material is removed by "backwashing" with filtered water at a high rate for a short period of time. The amount of water required for "washing" is usually about 2 percent of that filtered.

The Central District Plant is being designed by the Filtration Design Division of the Bureau of Engineering in Chicago's Department of Public Works—in consultation with the city's Department of Water and Sewers. The Bureau of Engineering is the city's major agency for the design and construction of capital works, and the Department of Water and Sewers operates all the city's water works facilities.

George L. DeMent is Commissioner of Public Works, Dick Van Gorp, A.M. ASCE, is Chief Engineer, and George S. Salter, M. ASCE, is Chief Filtration Engineer. Arne Anderson is Resident Engineer at the plant site and Frank Misischia is Resident Engineer on the tunnels.

Construction of the plant is being financed entirely by monies received from the operation of the water works system. Water works certificates issued for its construction are retired by water revenue. No tax money is used.

FIG. 4. Flow diagram indicates movement of water from Lake Michigan through plant to distribution lines serving northern two-thirds of Chicago.



RAY BLASONGAME, formerly Project Superintendent, Grafe-Tecon-Mittry-Drake, Chicago, Ill.

WALTER R. LAW, Special Representative, Atlas Powder Company, Wilmington, Del.

Tunneling with rotary drills and millisecond delay blasting

Rotary rock drills have proved successful in their first use in tunneling on 27,000 ft of underwater connections to the new Chicago Central District Filtration Plant. And millisecond-delay electric blasting caps, long looked upon with misgivings by tunnel men, have won complete acceptance from crews driving the five-mile tunnel through sedimentary limestone, 250 ft beneath Chicago's Gold Coast.

Hydraulic drills have been used in quarrying and mining but this is their first known use in construction tunneling. The drills have been used on headings worked each way from a shaft near the center of the tunnel connecting the filtration plant to Chicago's North Water District. (See map, p. 51.) The horseshoe-shaped tunnel is 15 ft 1 in. wide and 16 ft high at the center of the arch inside the lining, the excavation is about 17 x 19 ft in section.

Working in dolomitic limestone, Joy Manufacturing Company's HPD-4 drills cut a hole of 1⅝-in. diameter 11 ft deep in 2 min or less. Four drills complete a 58- to 64-hole pattern while a Ka-Mo drill of 14-in. diameter cuts a 15-in. center burn to the same depth. There is little noise and no fog at the heading as no air is released from pressure. In fact, no compressed air is piped to the heading as air change is provided entirely by suction through a 24-in. line.

The Ka-Mo drill for the center cut is mounted on a retractable carriage on the drill jumbo about 10 ft above the tunnel floor. Four HPD-4 drills are mounted on the front of the jumbo on a highly maneuverable mounting that makes it possible to reach almost all the holes with at least two drills. Each drill has a 30-hp motor that drives a hydraulic pump. Hydraulic pressure is used to position the drill frame, to provide the thrust, and to rotate the bits. The steel-frame drill jumbo operates on rails set at 10.5-ft centers with a 37-ft wheelbase for the main frame.

Short delays speed job

The so-called "short delay" blasting caps are credited with substantially speeding the Grafe-Tecon-Mittry-Drake joint-venture operation, which has averaged a daily advance of more than 120 ft at two headings. Since the development of millisecond delays 12 years ago, powder men have been puzzled by their slow acceptance in tunnel work. Whereas millisecond blasting has become almost standard in open-cut excavation, tunnel drivers, with rare exceptions, have stuck by the older, standard delay electric caps with a half-second interval. However, actual on-the-job comparison of results proved the superiority of millisecond blasting on the Chicago Water Tunnel job. Perhaps the techniques developed there will provide the experience needed to accelerate their more general application for better blasting underground.

Both ways tried

At the beginning of the operation, and with the assistance of C. L. Goldner, special Atlas representative from San Francisco, both millisecond delay and standard delay electric blasting caps were used in experimental rounds. Experience proved conclusively that the short-delay, millisecond caps provided the following definite advantages in the sedimentary limestone:

1. A loose muck pile, easier to dig
2. Better fragmentation
3. Fewer noxious fumes, hence less lost "smoke time"
4. A cleaner cut, hence less scaling
5. Lower powder factor
6. Fewer vibration complaints in built-up areas

The primary objection to millisecond "short-delay" blasting in tunnel driving has been its tendency to throw rock excessively, resulting in scattered, slow-to-dig piles. This action has been attributed to its more nearly simultaneous action as compared to the longer interval of standard delays. The blast pattern evolved from the experimental rounds overcame this objection by skipping delay periods between many adjacent holes to lengthen the time interval between their detonation.

The resulting pile is strung out along the tunnel somewhat more than

Jumbo is at face, ready for drilling. Rotary drills operate without chatter or the fog created by release of compressed air.

piles normally resulting from standard delay patterns. However, the pile is in no sense scattered, and since it is loose and well broken, it is mucked out much more quickly than the hard-to-dig, keyed muck pile left by the standard delay shots. The digging time saved is significant. Short-delay shots cut mucking time by as much as 20 min per cycle.

Experience has shown that the use of Rockmaster's millisecond delay caps reduces the smoke time by a good 30 percent. This is attributed to the smaller quantity of explosives required and a more efficient utilization of explosives energy.

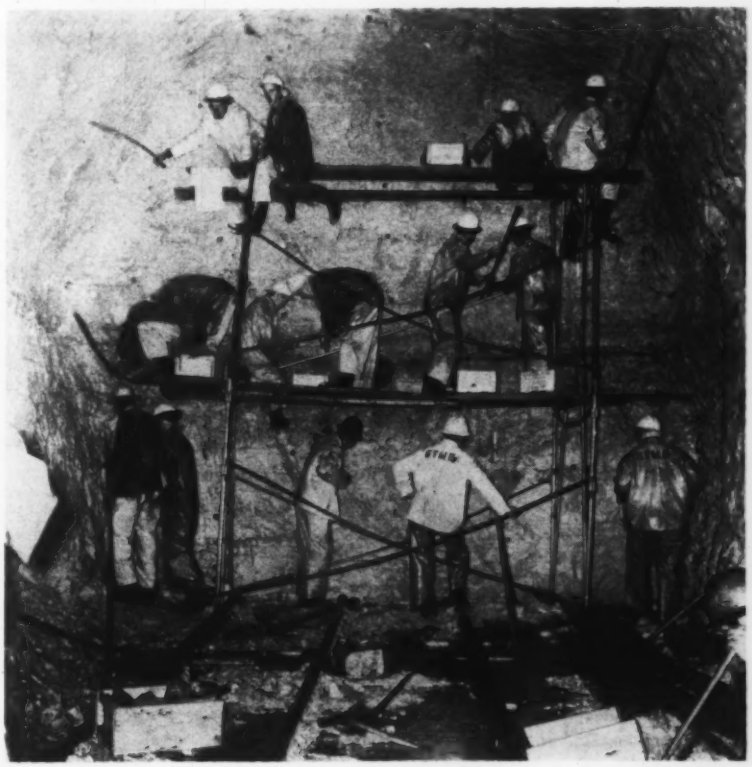
The discovery that a lower powder factor provides superior results was the clinching evidence on a job that consumed 1¾ million lb of explosives. About 5 lb of explosives per cu yd of in-place rock is needed on most tunnel operations in this type of material; a powder factor of less than 4 lb to 1 cu yd has been sufficient here.

Secret is timing

The secret of the successful millisecond delay blasting pattern is the use of an entire series of delays in order to skip delay periods between adjacent holes when necessary. This tends to stretch out the initiation sequence—but not so much as to lose the superior fracturing effect of the rapid shooting progression.

As shown in Fig. 1, the blasting

A round is quickly loaded from scaffolding. To prevent overloading the shot, only first few cartridges are tamped tight. So-called "short delay" blasting caps are credited with substantially speeding the Grafe-Tecon-Mittry-Drake joint venture, which has averaged a daily advance of more than 120 ft at two headings on Chicago Water Tunnel job.



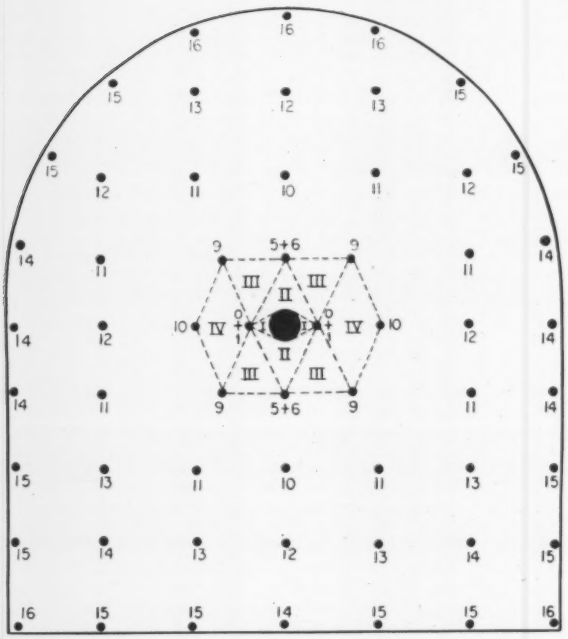
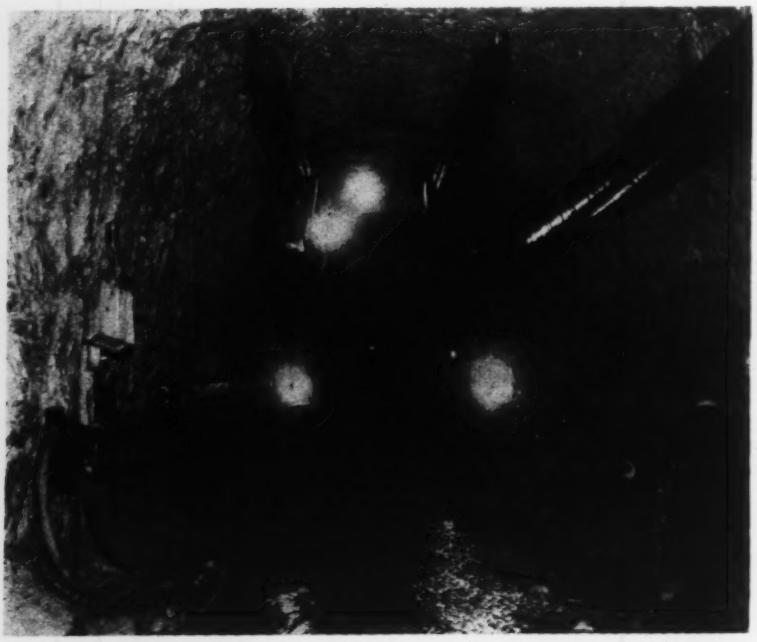


FIG. 1. Blasting pattern for typical heading round in Chicago water tunnel consists of 58 holes. They are 11 ft deep, of 1⅝-in. diameter, and primed with Atlas Rockmaster caps having delay periods indicated. Auger-cut center hole, of 14-in. diameter, provides relief for action of first cut holes. Roman numerals indicate sequence of initial rock movement.



Four 1⅝-in. rotary drills are positioned by fully hydraulically controlled mountings on drill jumbo. Drill of 14-in. diameter for center burn is retractable.

pattern in the 16-ft tunnel employs a large-diameter hole in the center of the heading. This hole is bored by a 14-in. Ka-Mo rock drill mounted in the center of the drilling jumbo. Drilled the full depth of the round, the large-diameter hole is left empty to provide relief in the center of the cut. It is estimated that it takes the place of nine small-diameter conventional burn-cut holes.

The 1⅝-in. powder holes are 11 ft deep, primed with Atlas Rockmaster millisecond delay electronic blasting caps in the sequence shown in Fig. 1. The numbers indicate the rated delay employed in each hole to give the split-second firing intervals shown. Note the delay periods which are skipped between successive holes radiating from the center. The longest delays between holes are in the center of the cut, where it is important for the broken rock to clear the heading before the next holes fire, in order to prevent freezing the critical center of the cut. Farther out, the interval need only be enough for the movement of the burden of the previous hole to be well under way before the explosive in the next hole shoots.

Holes nearest to the center of the cut are primed to fire first and the detonation radiates progressively outward. In Fig. 1, the roman numerals indicate the sequence in which the critical, tight center wedges come out to provide relief for successive rings of holes.

The 58 holes in Fig. 1 are a typical pattern. The number may vary with the condition of the rock and the personnal preferences of the shifters, but the basic pattern is followed closely. No holes are spaced more than 36 in. apart. This is an especially critical consideration on the rib and lifter holes along the perimeter, where wider spacings may leave humps between holes. To make room for the concrete liner, the tunnel is cut at least 8 in. beyond the specified finished dimensions in all directions.

Loading details are shown in Fig. 2. The four holes nearest the large-diameter auger hole in the center are double primed from front to rear to provide a shooting effect. The two alongside and nearest the auger hole (Fig. 2,*A*) are loaded with a zero delay cap in the collar and a No. 1 Rockmaster (firing 0.008 sec later) at the bottom of the hole. Thus the wave of detonation passes from the face into the rock so as to shoot outward the two wedges labeled roman "I" in Fig. 1, clearing the center and providing relief for subsequent firing holes. The second cap insures complete detonation of these important cut holes.

The two cut holes directly above and below the auger hole are similarly primed except that they fire 100 milliseconds (0.1 sec) later, after the action of the first two holes is complete.

All other holes, relievers, ribs and lifters, are loaded as shown in Fig. 2,*C*. They are primed in the bottom for maximum energy confinement, insuring maximum fragmentation with minimum throw. Note that only half the cartridges are tamped so that an adequate column of powder is obtained without overloading the round.

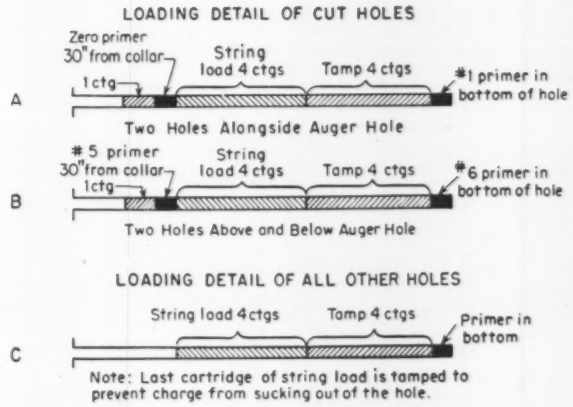


FIG. 2. In loading a tunnel round, critical first four cut holes are double primed to shoot from the collar, giving shooting-out effect. Caps at bottom of holes next to auger hole insure complete detonation of these holes, which must pull effectively or shot may freeze in place.

120 ft per day

Normally each of the three crews on each heading completes two cycles of drilling, shooting and mucking during every working shift, and sometimes they start a third. Since the 11-ft rounds pull 10½ ft of rock, each crew advances the heading more than 20 ft per day. The record 24-hour advance is 140 ft in both headings, or 94 ft when working a single heading. In addition, crews are responsible for advancing the utility and service lines as they progress.

After the drilling for a round is completed and the jumbo withdrawn, the scaffolding is moved forward and the holes are loaded immediately. The basic powder load is Atlas Gelodyn No. 1 in 1¼ x 16-in. cartridges, with primers of Atlas 40 percent Giant Gelatin in 1¼ x 8-in. cartridges. Both the semi-gelatin Gelodyn and the ammonia gelatin Giant Gelatin were chosen for good water resistance and fume rating as well as their strength and economy. A total of about 400 lb of explosives is used on each shot.

Shooting

The primer cartridges are prepared in advance in a special make-up room and are carried to the heading in special compartmented wooden boxes—a separate compartment for primers of each delay period. After the holes are loaded, equipment is withdrawn a safe distance while the shot is hooked up.

The cap-leg wires are connected in parallel and hooked to the 440-volt power line through 14-gage copper lead wires and 12-gage aluminum bus line. A double-pole, double-throw safety switch in the power line at the transformer assures that no current reaches the shooting cable until the crew is set for the shot. The shot is fired with the blasting switch located from 600 to 1,000 ft back from the heading.

Within 10 min after a shot is fired, smoke and fumes have abated sufficiently for the Conway 100-1 mucking machine to move in and start cleaning up. In about 60 min, it loads some twenty-two 10-cu yd, rotary-dump mine cars. A cherry-picker type of muck-car shifter, on the rear of the jumbo, lifts an empty 10-cu yd car and holds it while the loaded cars are pulled back, then lowers it at the head of the train. Loaded cars are hauled, by one of eight Goodman electric locomotives working in the hole, to the working shaft where a rotary dump empties them into a 12-cu yd muck skip. Skips are hoisted to the surface on a 5-min, 20-sec round-trip schedule.

Concrete placing

Concreting now is under way on the project. Curb is being placed in the north section of the main tunnel. Central-mix concrete delivered by truck mixer is dropped 250 ft through a 10-in. pipe into a shock-absorbing boot. Concrete flows to a loading hopper and to a truck-type agitator car of 7½-cu yd capacity. Three of the agitator cars make up a train for delivery of concrete directly to the curb forms.

For the arch it is planned to use a 350-ft telescoping form. The same agitator cars will deliver concrete to a Rex 200-double Pumperete machine for placing. It has been observed that there is no segregation of the mix in the 250-ft drop. The batches enter the shock-absorbing boot, which in effect acts as a remixer, where the concrete churns before flowing to the loading hopper.

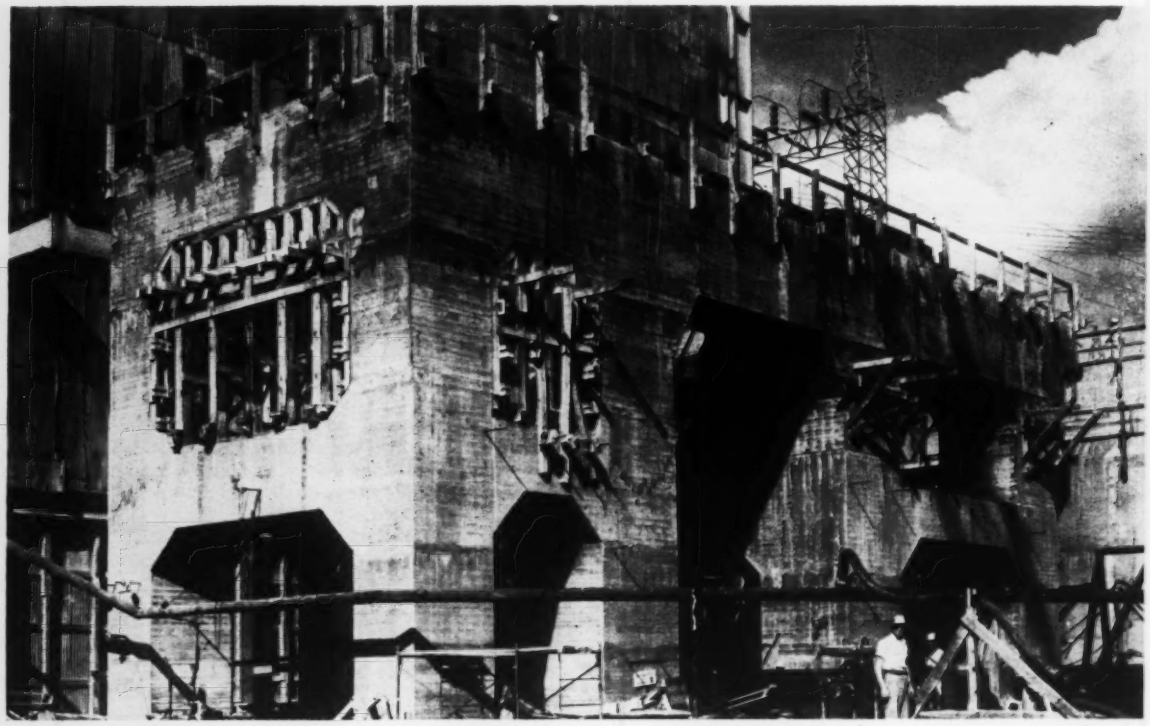
Arch lining is being installed on the 20-ft raw-water intake at the site of the new filtration plant. Concrete is being pumped from the surface down 200 ft and through 1,000 ft of tunnel with a 200-double and a 160-single Rex Pumperete machine.

Ventilation is provided within the tunnel by a 24-in. air line that handles 10,000 cfm in each heading. The system is driven with Joy Axivane fans located at 1,000-ft intervals, and one 20,000-cfm fan atop the entrance shaft. The air line is kept within 75 ft of the heading by the tunnel driving crews in order to keep good air at the work area and to reduce smoke time to a minimum.

Power comes from 2,300-volt power lines and is converted to 440 volts by transformers which are kept within 500 to 1,500 ft of each heading. Water for the drilling operation is provided by a 4-in. line.

The north heading was holed through on November 14, and excavation of the longer south heading is scheduled for completion in late February. December 19, 1958, is the target date for completion of the overall project, which includes 3,800 ft of shorter rock tunnels, 500 ft of stub tunnels, and seven shafts.

The 32,000 ft of tunneling is being done under a $12,700,000 contract for the Department of Public Works of the City of Chicago. Contractors are Grafe-Callahan Construction Co. of Los Angeles, Tecon Corp. of Dallas, Mittry Constructors of Los Angeles, and Johnson, Drake & Piper, Inc., of Minneapolis and New York, operating as Grafe-Tecon-Mittry-Drake. Grafe-Callahan is the sponsor. Job personnel includes Fred Brandt, J.M. ASCE, project manager; Merl Miller, now project superintendent; and T. W. Kadel, project engineer.



In turbogenerator foundation for Unit 7 at Johnsonville Steam Plant, TVA fly ash replaces 20 percent of the cement and 10.5 percent of the sand. Mechanically collected fly ash was used for first time in four-unit extension to this plant.

TVA USES NON-SPECIFICATION

Fly ash that does not meet the specific surface fineness requirement of the specifications of the American Society for Testing Materials is being used effectively by the Tennessee Valley Authority in the concrete for Units 7 to 10 at its Johnsonville Steam Plant and in the 450,000-cu yd Wilson Dam lock. Tests both in the laboratory and in the field have shown that fly ash recovered by mechanical collectors in TVA steam plants is as useful as the product from electrostatic precipitators, if properly used.

Fly ash is an artificial pozzolan. A pozzolan is defined as "a siliceous or siliceous and aluminous material like volcanic ash, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties." Calcium hydroxide is liberated during the hydration of portland cement, and pozzolans combine with this liberated lime to form a hard, durable compound which is mostly insoluble silicates. Natural pozzolans, such as volcanic ash, have been used for over 2,000 years. A mixture of volcanic ash and calcined limestone formed the hydraulic cement used in such enduring Roman structures as the Pantheon in Rome.

"Fine" fly ash collected by electrostatic precipitators has been used for several years as an admixture in concrete and also to replace a part of the cement. The Hungry Horse Dam in Montana, built by the Bureau of Reclamation, is probably the best known large structure in which this material was used. About 32 percent of the cement was replaced by fly ash in the basic mix for the interior mass concrete of this 3,000,000-cu yd structure. This mix contained two sacks of cement and 90 lb of fine fly ash.

Ash meeting the current ASTM fineness requirement of 2,800 sq cm per gram (Designation C 350–54 T) can only be collected by electrostatic precipitators of the sort installed in many coal-burning steam-electric stations in congested areas. These precipitators capture the very fine ash before it is blown up the chimney by induced-draft fans, whence it eventually settles to the ground. Actually the specific surface of the ash from these precipitators ranges from 2,800 to 4,500 sq cm per gram.

Basically, the electrostatic process for recovering fly ash consists of charging the suspended particles in the corona discharge and subjecting these charged particles to an electric

Lock at Wilson Dam, seen under construction from top of dam, contains fly ash from TVA's Colbert Steam Plant. Advantages shown by TVA and Bureau of Reclamation tests include increased ultimate strength and greater watertightness.

FLY ASH

GEORGE K. LEONARD, M. ASCE, Chief Engineer
PHILIP A. SCHWAB, Materials Engineer
Tennessee Valley Authority, Knoxville, Tenn.

field. This causes the particles to migrate to collecting electrodes from which, in the form of relatively large agglomerated masses, they are moved to receiving hoppers. By this process much finer material is collected than could be recovered with collectors of the mechanical type.

TVA fly ash

TVA's seven modern steam plants annually burn over 18 million tons of pulverized coal, of which about 73 percent can be passed through a 200-mesh sieve. This coal is blown into the furnace along with air, and combustion takes place while the coal is in suspension. About 80 percent of the resulting ash is dry fly ash and about 20 percent is bottom ash or slag. About 75 percent of the dry fly ash is recovered by mechanical-type collectors—standard equipment in all the plants. TVA is currently producing over 1,000,000 tons of dry fly ash a year. This ash is considerably coarser than the electrically precipitated material. The problem is to profitably utilize this coarser material instead of sluicing it to waste dumps, along with the bottom slag and the rejects from the pulverizers.

The mechanical-type collector has a series of vanes which cause a high-velocity rotary motion of the exhaust gases, thus separating the entrained solid particles by centrifugal force. In one make of collector, the gas passes downward, with a spiral motion, to the conical section at the lower end. There the flow is reversed and the cleaned gas whirls upward and out through an inner tube. The separated solid material is discharged from the bottom cone into a collection chamber.

Mechanically collected fly ash was used by the State of Alabama in the 2.5-mile-long Dauphin Island Bridge and in the Herron Bay and Fowl River bridges near Mobile. The typical concrete mix contained 5 bags of cement and 3 percent of entrained air. Twenty percent of the cement, by weight, was replaced by fly ash with a resulting 28-day compressive strength of 4,500 psi.

Johnsonville concrete

Mechanically collected fly ash was first used by TVA in the four-unit extension to its Johnsonville Steam Plant now under construction. This plant has the same make of collectors as the plant that furnished fly ash for the bridges near Mobile. Thirty-one samples of the Johnsonville fly ash had an average specific surface of 2,000 sq cm per gram (Blaine). The fineness of individual samples ranged

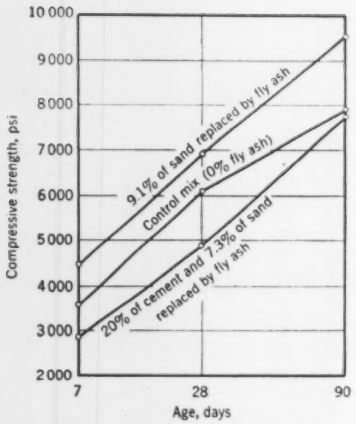


FIG. 1. Comparative strengths of mortar mixes using Johnsonville fly ash and Tennessee River sand are shown by results of cylinder tests.

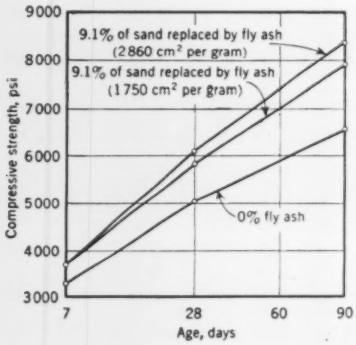


FIG. 3. Compressive strengths of mortar mixes containing Ottawa standard graded sand and Colbert fly ash of two different finenesses exceeded that of control mix at all ages. Fly ash of top curve had been processed in laboratory to meet ASTM fineness requirement of 2,800 sq cm per gram.

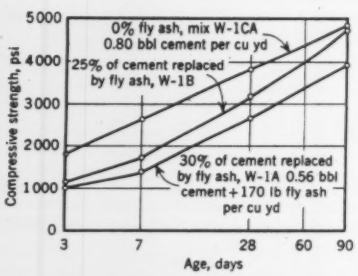


FIG. 4. Age-strength relationships are given for three trial mixes of interior concrete for Wilson Lock, with 6-in. maximum-size aggregate. Details of mixes are given in Table II.

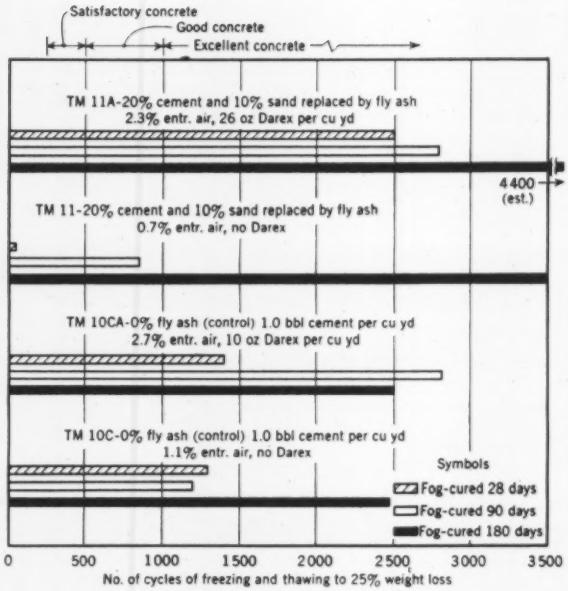

Satisfactory concrete
Good concrete
Excellent concrete
TM 11A-20% cement and 10% sand replaced by fly ash
2.3% entr. air, 26 oz Darex per cu yd
4400 (est.)
TM 11-20% cement and 10% sand replaced by fly ash
0.7% entr. air, no Darex
TM 10CA-0% fly ash (control) 1.0 bbl cement per cu yd
2.7% entr. air, 10 oz Darex per cu yd
TM 10C-0% fly ash (control) 1.0 bbl cement per cu yd
1.1% entr. air, no Darex
Symbols
Fog-cured 28 days
Fog-cured 90 days
Fog-cured 180 days
0
500
1000
1500
2000
2500
3000
3500
No. of cycles of freezing and thawing to 25% weight loss

FIG. 2. Durability tests performed in Denver laboratory of U. S. Bureau of Reclamation show need for use of an air entraining agent in fly-ash concrete. With 2.3 percent of entrained air, fly-ash concrete has greater durability than regular concrete at all ages. These are trial mixes for Wilson Dam face concrete, with 3-in. maximum-size aggregate.

from 1,590 to 2,630 sq cm per gram. Tests on mortar cylinders made with this material gave the results shown in Fig. 1.

In the 50,000 cu yd of concrete for the Johnsonville Units 7 through 10, the ash was used with river sand, and with crushed limestone as the coarse aggregate. Here 20 percent of the cement and 10.5 percent of the sand were replaced by fly ash. Since the river sand was deficient in fines (only 1.5 percent passed the 100-mesh screen), the addition of fly ash greatly improved the workability of the mix.

The average compressive strength of twenty 6- by 12-in. cylinders made from face concrete containing 1½-in. aggregate, placed during a period of several months, is shown in the following table.

Age, Days	Av. Compres. Strength, psi
7	2,609
28	4,446
90	6,120
180	6,800

The mix, which contained 1.1 bbl of cement, 227 lb of fly ash from the Johnsonville plant, and 939 lb of sand per cu yd, had an average slump of 3¼ in. and 3 percent entrained air. The compressive strength of this mix, after fog curing for 90 days, was equivalent to the strength of the reference mix, which contained no fly ash but had 1.375 bbl of cement per cu yd.

Wilson Lock concrete

Fly ash from TVA's Colbert steam plant is being used in the new lock now under construction at Wilson

TABLE I. Colbert fly ash compared with portland cement

	Colbert Fly Ash*	Type II Cement
Silica	42.5	22.3
Alumina	18.8	4.0
Ferric oxide	24.9	4.6
Magnesia	1.1	3.3
Calcium	6.6	...
Sulfuric anhydride	0.9	1.6
Carbon	3.4	...
Ignition loss	3.5	0.9
Alkali	0.40	0.40
Tricalcium silicate	...	41
Tricalcium aluminate	...	4.5
Fineness, specific surface (Blaine)	1750†	3160
Passing 325 mesh, %	60‡	...
Passing 200 mesh, %	90	...
Specific gravity	2.46	3.1

*Average of samples which were taken over a period of one week.

†Specific surface of individual samples varied from 1700 to 2000 sq cm per gram.

‡Fineness of individual samples varied from 60 to 70%.

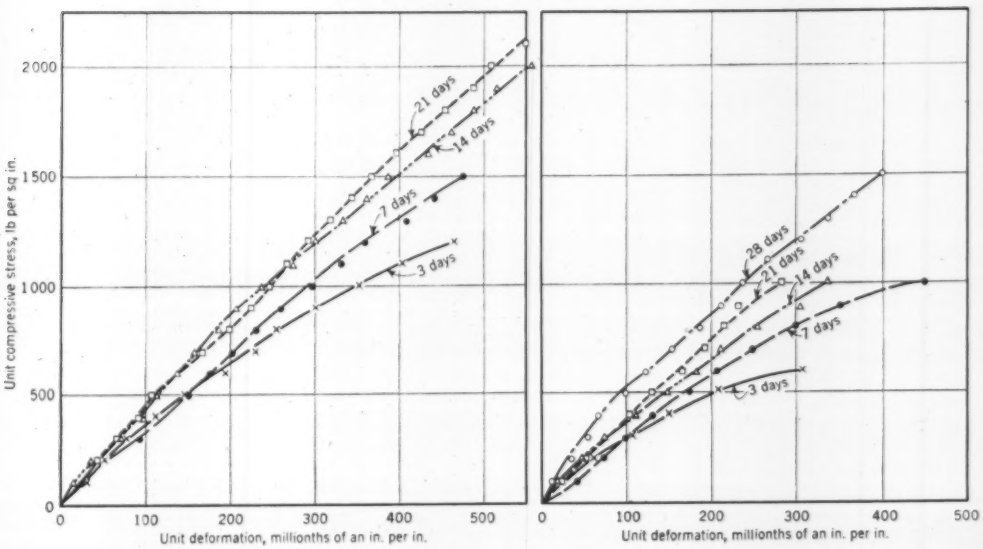


FIG. 5(a). Modulus of elasticity for mass-concrete mix without fly ash.

Age, Days	Modulus of Elasticity				
	500 lb	1000 lb	1500 lb	2000 lb	2500 lb
3	3.5×10^6	2.9×10^6			
7	3.3	3.4	3.2×10^6		
14	4.5	4.3	3.9	3.6×10^6	
21	4.6	4.1	4.1	3.9	3.6×10^6

This is mix W-1CA in Table II and Fig. 4, used for Wilson Dam mass concrete with 6-in. maximum-size aggregate.

FIG. 5(b). Modulus of elasticity for mass-concrete mix with fly ash.

Age, Days	Modulus of Elasticity		
	500 lb	1000 lb	1500 lb
3	2.4×10^6		
7	2.6	2.2×10^6	
14	3.3	3.0	
21	3.8	3.5	
28	5.0	4.2	3.8×10^6

This is mix W-1A in Table II and Fig. 4, used for Wilson Dam mass concrete with 6-in. maximum-size aggregate.

Dam, Alabama. Colbert ash meets the requirements of ASTM Designation C350-54T, in so far as chemical specifications are concerned, but the average fineness is about 36 percent less than the ASTM requirement of 2,800 sq cm per gram. Recent tests, reported in the February 1957 issue of *Public Roads*, indicate that in evaluating the suitability of fly ash for use in concrete, the screen analysis is a more significant measure of fineness than specific surface by air permeability. About 65 percent of the Colbert ash passes a 325-mesh screen. Twenty samples of electrically precipitated fly ash reported by the ASTM in 1954 averaged 78 percent passing a 325-mesh screen. On this basis, therefore, the Colbert ash has a fineness of 84 percent that of electrically precipitated ash.

The analysis of Colbert ash, compared with the Type II cement with which it is being used, is shown in Table I.

After a careful study of the chemical analysis of the Colbert fly ash, results of freezing and thawing tests made by the U.S. Bureau of Reclamation laboratory at Denver, compression and workability tests by the TVA laboratory, and other data, it was decided that excellent concrete could be made with non-specification fly ash as a replacement for part of the portland cement and sand in concrete. The resulting concrete would have the strength and durability required for TVA hydraulic structures; it would yield a considerable saving and other appreciable advantages, such as:

1. Increased ultimate strength. In the concretes tested, with fly ash re-

TABLE II. Trial mixes for Wilson Lock mass concrete with 6-in maximum-size aggregate

(See Figs. 4 and 5)

Lab. No.	Compressive Strength, psi			Portland Cement, bbl per cu yd	% Fly Ash Replacing		W/C	Vinsol Resin, oz per cu yd	% Entr. air	% of Total Aggregate in Mix*				
	3-day	7-day	28-day		Cement	Sand				Sand	¾" stone	1½" stone	3" stone	6" cobb.
W-1A	1022	1424	2710	0.56	30	8.6	0.60	26	4.7	24.5	17.0	17.0	20.5	21.0
W-1B	1185	1778	3196	0.60	25	8.6	0.63	18	1.7	24.5	17.0	17.0	20.5	21.0
W-1CA	1834	2676	3890	0.80	0	0	0.64	6	4.7	26.0	17.0	17.0	20.0	20.0

*These mixes were designed with all fly ash considered as part of the "paste," that is, cement, water, entrained air, and fly ash. Ratio of total weight of fly ash used to weight of cement replaced is 1.9:1 in mix W-1A, and 2:1 in mix W-1B. Manufactured sand contained 3.8% passing 100-mesh and had a fineness modulus of 3.2. Type II portland cement was used. Control mix, W-1CA, had a slump of 1¼ in.; slump of two fly-ash mixes was 2 in. Aggregate was crushed limestone.

placing part of the portland cement and sand, the weight of the fly ash in the mix varied from 1.5 to 2.5 times that of the portland cement replaced. For these concretes, the 28-day strengths were close to those of the control concretes containing no fly ash; the 90-day strengths were usually higher. It is expected that the fly-ash concrete will continue to gain strength at an appreciable rate so that after a year or so its ultimate strength will be considerably higher than that of a comparable straight portland cement concrete.

2. Reduced lime leaching. The lime liberated during hydration of the portland cement combines with the fly ash to form a very stable product.

3. Greater watertightness. Fly-ash concrete is much less permeable to water than straight portland cement concrete.

4. Reduced drying shrinkage. The inclusion of fly ash usually cuts down on the amount of water required to produce a workable concrete, and with less water there is less drying shrinkage.

5. Improved workability. Fly-ash concrete is more workable because of the spherical shape of the fly-ash particles. This increased workability usually permits a lower water-cement ratio.

TVA fly ash meets the specifications of both the U. S. Bureau of Reclamation and the ASTM, except for fineness (or surface area). For example, the Johnsonville ash has an average surface area of about 2,000 sq cm per gram, whereas the ASTM requires a minimum of 2,800, the same as required for portland cement.

Since the coarser ash makes the workability of the concrete somewhat less than it would be if made with an equal quantity of portland cement, it is necessary to add fly ash in excess of the amount of cement replaced in order to get good workability and adequate strength. Some of the producers of electrically precipitated fly ash recommend adding 1½ lb of fly ash for each pound of cement replaced. The excess volume resulting from this addition is compensated for by a corresponding reduction in the volume of sand in the mix. The coarse fraction (35 percent of the Colbert fly ash), which is material retained on the 325-mesh screen, may be regarded as a substitute for fine sand.

Adequate compressive strength in the trial mixes for Wilson Lock, with a cement replacement of 20 percent, was obtained by increasing the amount of fly ash in the mix to provide a replacement for part of the sand. For example, in the face mix with 3-in. maximum-size aggregate, the replacement ratio of total fly ash to cement was 2.2:1 (by weight). In the mass mix, with 6-in. maximum-size aggregate, the ratio was 1.9:1, where 30 percent of the cement and 8.6 percent of the sand was replaced by fly ash. If all the fly ash retained on a 325-mesh screen is considered as fine sand, then the ratio of the remaining minus 325-mesh fly ash to the cement replaced is only 1.3:1 in the 3-in. face mix and 1.1:1 in the 6-in. mass concrete.

Research by others has demonstrated that hydrated lime is liberated by regular portland cement concrete at the rate of about 18 lb per sack of cement at the age of 90 days. Sufficient minus 325-mesh fly ash must be present in the mix to combine with this free lime if full pozzolanic action, and consequent maximum strength, is to be obtained, since the active pozzolan in the fly ash is largely contained in the material passing the 325-mesh screen.

Because the coarse fraction of the fly ash has the effect of increasing the minus 100-mesh material in the sand, the specifications covering manufactured sand for Wilson Lock limited the material passing a 100-mesh screen to 6 percent. The limestone sand, which is being used, contains about 4 percent minus 100 mesh. If this is added to the plus 325 fraction of the fly ash in the mass concrete with 6-in. aggregate, the sand may be considered as containing about 10 percent passing the 100-mesh screen.

Results of durability tests performed in the Bureau of Reclamation laboratory at Denver are shown graphically in Fig. 2. The freezing and thawing tests indicated that when there is a deficiency of entrained air, the fly ash concrete, if cured less than 90 days before freezing starts, will fail at a much lower number of cycles of freezing and thawing than regular concrete. It is necessary, therefore, to use an air-entraining solution in fly-ash concrete to obtain adequate durability on specimens cured less than 90 days before freezing starts. These tests also indicated that when 2.3 percent of entrained air is present in the mix, fly ash concrete has greater durability than regular concrete at all ages.

Another test was made to determine the compressive strength of mortar with Colbert fly ash, made in accord with ASTM C311-54T (Fig. 3). This strength was 116 percent of the control mix (which contained no fly ash) at 28 days and 120 percent at 90 days.

The age-strength relationship of three trial mixes of mass interior concrete for Wilson Lock is given in Fig. 4. Details of the three mixes are given in Table II. For two of these mixes, the modulus of elasticity was determined by tests on 6- by 12-in. cylinders as given in Fig. 5. Concrete in the cylinders was wet screened to remove aggregates larger than 1½ in. Each point on the curves is the average of tests on two cylinders.

Tests of the tensile strength were made on briquets in accord with ASTM C190-49 with mortars containing Colbert fly ash and a control mix without fly ash. These tests were made to determine the ratio of tensile strength to compressive strength of fly-ash concrete and also to compare its tensile strength with the tensile strength of regular concrete. Ottawa standard graded sand was used with Type II cement. After fog curing 28 days, the mortar, containing fly ash replacing 20 percent of the cement and 9 percent of the sand, had a compressive strength of 3,930 psi, which was 78 percent of the strength of the control mix which contained no fly ash. The tensile strength of the fly-ash mix at 28 days was 459 psi, which was 97 percent of the strength of the control mix.

Concrete blocks

Colbert fly ash was used experimentally in making 8- by 8- by 16-in. concrete building blocks at a large plant in Tupelo, Miss. The blocks containing fly ash had a smoother texture than those normally produced, and their strength at 8 days exceeded the Underwriters' Laboratories specifications for compressive strength at 28 days. The mix contained fly ash replacing 25 percent of the cement and 7 percent of the expanded slag aggregate.

It is concluded that:

1. TVA mechanically collected fly ash, if used to replace part of the sand as well as part of the cement, can be profitably utilized in producing concrete that is superior to plain concrete.

2. Use of fly ash benefits lean concrete mixes more than richer ones, in both workability and strength.

3. Durability tests indicate that fly-ash face concrete should contain at least 2.3 percent of entrained air to insure adequate durability.

4. From three to four times the amount of air-entraining agent normally used is required when fly ash is used to replace a percentage of both sand and cement in the mix.

5. Judging by results obtained with similar ash, TVA fly ash has a large potential use in highway construction as a filler in bituminous mixes and in the manufacture of lightweight aggregates.

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Lift-slab construction for college dorm features precast concrete columns

Steadily increasing enrollment recently made it necessary to enlarge the dormitory facilities at Arizona State College, at Tempe, Ariz., a city which practically touches Phoenix. The new women's dormitory housing 600 students consists of four three-story wings and a one-story administration section. It was built of concrete flat-plate floor and roof construction utilizing the lift-slab technique. As shown in Fig. 1, the administration building forms the core with two wings each side of it.

A corridor extending the full length of each floor in the wings terminates at end stairways. Under the corridor ceiling runs a plenum chamber for air-conditioning ducts and utilities. The under side of each slab forms the ceiling of the room below. Since this was not plastered, but only painted, it was imperative that no form marks show. Lift-slab construction makes this arrangement feasible as no floor forms are used. A typical plan of a dormitory wing is given in Fig. 2 and a typical transverse section in Fig. 3. Exterior walls are 8-in. brick, and in each bay two window-wall units extend from floor to ceiling.

The second and third floors and the roof of each wing were cast at ground level in two 8-column units on the previously poured slab, each unit being 90 ft 6 in. long by 48 ft 8 in. wide, with a 3 ft 0 in. gap between units. If the slab had been poured in one 16-column unit, a special lifting setup would have been required. The lift-slab system is most economical when applied to units supported on not more than 12 columns. The masonry stair towers at the ends of the wings were completed before pouring of floor and roof slabs. A 1½-in. expansion joint separates the wing from the stair tower at each end. Floors are 10⅛ in. thick with a column spacing of 24 ft 0 in. by 26 ft 6 in. Along the sides, the slab cantilevers out 11 ft 1 in., and at the ends, 7 ft 10½ in.

Since flat plates are relatively sensitive to deflections, a deflection study was made for different column spacings. The 24-ft 0-in. spacing lengthwise of the wing was fixed by the room layouts; no transverse limitation was imposed. Exact analysis of deflections according to the theory of elasticity is practically impossible; however an approximate method was used which has given fairly accurate results in structures of this type. A strip of the slab bounded laterally by the centerline of the panel on each side of the column is considered as a beam on two supports with cantilevered ends. The biaxial effect, or the resistance to deflection in the longitudinal direction, is ignored.

Calculating the negative moments over the columns and considering the loading involved, the slopes of the slab at the columns can be computed, from which the deflection of the cantilevers is determined. The deflection at the center of the slab is calculated using these same negative moments and then multiplied by $\frac{1}{2}\,(L_d/L)^3$. The coefficient ½ takes into account the biaxial strength of the slab; L_d is the diagonal distance between columns, and L the transverse distance between columns. In our studies, the transverse spacing of 26 ft 6 in. seemed best.

The theoretical dead-load deflection of the roof at the drains, taking into account the variable thickness of the slab, was 1/16 in. upward; the actual deflection varied from zero to 3/16 in. At the cantilevers, the calculated roof deflection was ½ in. downward against ⅜ to ½ in. actual. For the floors, the theoretical deflection was zero at the panel mid-point against an actual deflection of zero to 3/16 in. upwards; the cantilever deflection, calculated as ⅜ in. downward, was actually ⅜ to ½ in. Incidentally, the architect wanted this much cantilever deflection so that rain water would run away from the curtain walls. After a month, the upward deflections of the panel center were reversed and the slab became practically level as a result of plastic flow of concrete. If the slab had been prestressed, deflections would not have been much of a problem as the prestressing would have created deflections opposite to the normal ones and the slab would have remained practically level. However, the architects as well as the College Board of Regents did not want to use prestressing since there were not enough qualified prestressing contractors in this area.

After the column spacing was established, the stresses in the slabs were determined by dividing the structure into a number of bents each consisting of a row of columns and strips of supported slabs bounded laterally by the centerline of the panel on each side of the columns. Bents were taken longitudinally and transversely. No moments were assumed to be taken by the columns under the lifting dead-load condition. For live load the columns were designed for bending moments.

A typical floor plan of a wing is shown in Fig. 2. Note the poured-in-place strip 3 ft wide. A part of the bottom steel in the transverse column strip is carried out to the end of the cantilevers to reduce the plastic flow of concrete and the resulting cantilever deflection. Two-thirds of the column-strip top steel is concentrated in the middle half of the strip because of the peak stresses in the slab at the columns. The bars are not welded to the collars to avoid the lateral bending stresses that would result in the latter if welded. The concrete had a strength of 3,750 psi.

The flat roof slab is very similar to the floors except that a drainage system is built in by reducing the slab

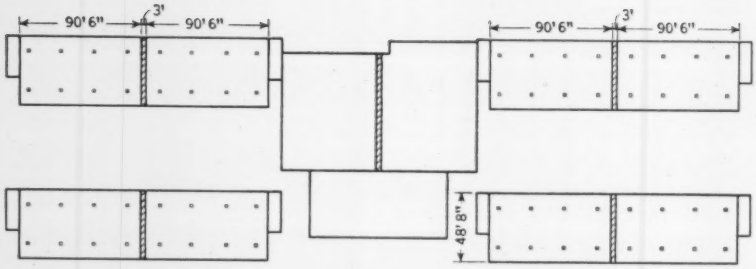


FIG. 1. Women's dormitory housing 600 students consists of four three-story wings and a one-story administration building in center.

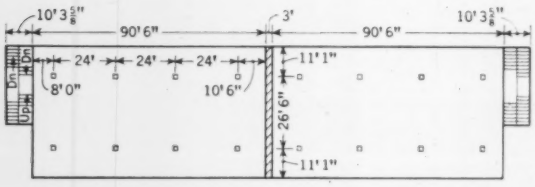


FIG. 2. In typical floor plan of dormitory wing, note 3-ft space between slabs, to be filled by cast-in-place concrete.

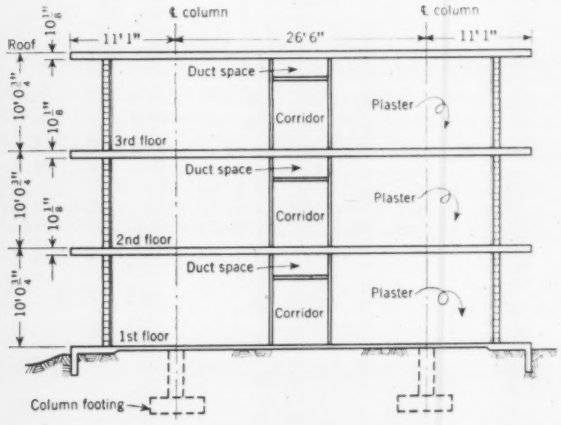
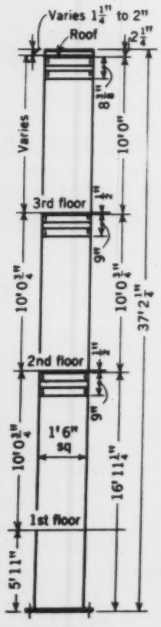


FIG. 3. Transverse section through a dormitory wing indicates general arrangement of corridors and rooms.



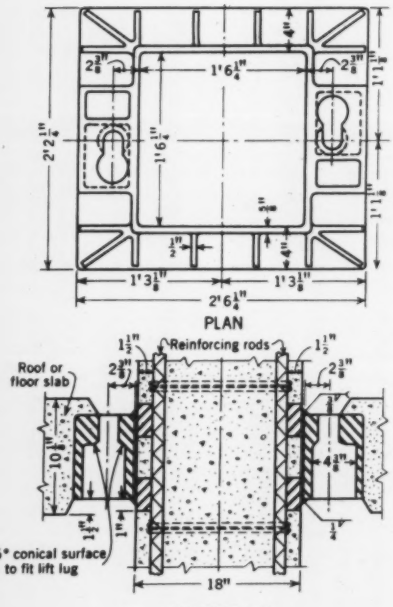


FIG. 4. Lifting collars carry slab up precast reinforced concrete columns. Note size and locations of welds.

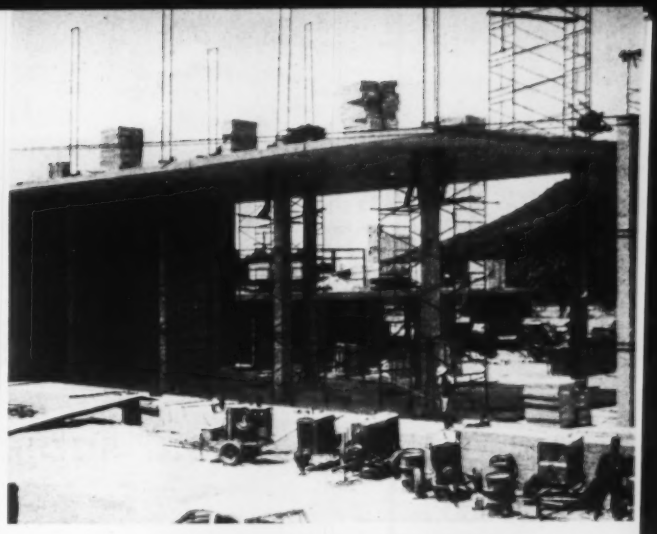
thickness from the normal 10⅛ in. at the edges to 8 in. at the drain in the center.

One of the unusual features of this project is the use of precast concrete columns made with 5,000-psi concrete. These were cast at the site and through the addition of calcium chloride were stripped and lifted into position in three days. Concrete columns were chosen when it was found that delivery of structural-steel columns would not be satisfactory. The concrete columns worked out so well that we now prefer them to steel because they give extra rigidity to the structure and need not be fireproofed. In the wings the columns are 18 in. square and in the one-story administration building, 14 in. square. The columns have a 1-in.-thick steel base-plate and four 1-in. anchor bolts. There are eight No. 9 reinforcing bars in the dormitory columns, which are 36 ft 2¼ in. high, and eight No. 6 reinforcing bars in the administration-building columns, which are 15 ft 6 $^{13}/_{16}$ in. high. Column ties were No. 3 spaced at 12 in. A $^{3}/_{16}$-in. steel cap plate was used at the top of each column to support the hydraulic jack for lifting slabs.

At each floor level and at the roof level, two steel collar bands are incorporated in the column, and to these the slab collars are welded. These bands are made up of bars 3 in. x 1½ in., set flush with the column faces and welded to the vertical reinforcing steel with electrodes of low-hydrogen iron-powder type. This type of electrode was used because of the rather high carbon content of the reinforcing steel, the thickness of the column-band bars, and the ease of slag removal. Threaded inserts were cast into the column ends for lifting eyes. Columns were cast in a horizontal position on a casting bed using steel-reinforced plywood forms. Use of calcium chloride, as previously mentioned, accelerated the strength development of the concrete so that the columns could be picked up in three days.

After the columns were erected, the ground floor was poured around them; then reinforcing steel was placed on it for the second-floor slab. To transfer the future slab load into the columns, collars were incorporated in the slab. These were of cast steel ASTM A 27, grade 60-30, with keyhole lugs by which the lifting rods would later raise the slab. As shown in Fig. 4, castings were made with a ⅛-in. clearance around the columns. The keyhole lugs allowed the lifting-rod head to be dropped into the large opening and then shifted laterally to bear on the conical surface for lifting.

Standard lifting equipment of the



U. S. Lift Slab Corporation was used and will not be described in detail. When the roof slab is in its final position, welders weld the under side of the slab castings to the collar bands on the columns. See Fig. 4 for size and locations of welds. At this point, the columns are under their severest loading because their unsupported length is at its maximum. They were analyzed on the basis of a cracked section with an arbitrary 2 percent of the axial load applied as a lateral force at the top, and buckling with base considered as fixed and top end free to move. The cracked section was used because it was felt that, when the columns were lifted from the form, bending cracks might occur. However, no discernible cracks were found in actual construction.

When all slabs of a wing are in place, the 3-ft gap between the two sections is formed and filled with concrete thus making the slabs monolithic. The locations of these poured-in-place strips are seen in Fig. 1. The rear section of the administration building was part of the second contract and was poured in place since the original work had already been finished.

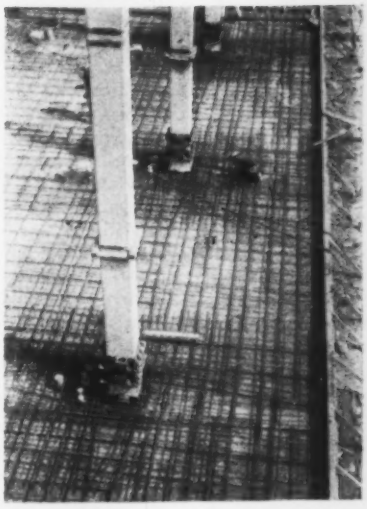
The original contract for Wings 1, 2 and 3 and for the administration building was with the Mardian Construction Company of Phoenix for $1,324,793. George Vaughn was General Superintendent in charge of construction. The addition to the administration building and Wing 4 were built by the T.G.K. Construction Co. of Phoenix for $418,500, thus bringing the total contract cost to $1,743,293. The lifting contractor was the Vagtborg Lift-Slab Corporation of Los Angeles, Calif., licensed by the United States Lift-Slab Corporation.

The architects, Weaver and Drover of Phoenix, are to be complimented on their efficient use of flat-plate construction. The structural engineer was the writer's firm.

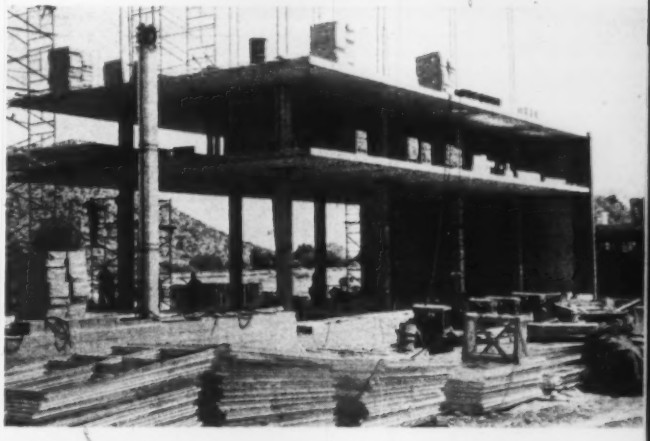
Above, left: Completed dormitory houses 600 students in four wings.

Above, right: Roof slab is in final position and welders are welding castings on under side of slab to collar bands on columns. Before roof slabs were lifted, all roofing material was placed on them for raising at same time.

Right: Steel for second-floor slab is in place, ready for concrete placing directly on ground-floor slab. Note spreading of top steel around columns, and under it, short steel for rectangular shearheads. Circular cans set at left of columns will form openings in slab for pipes.



Roof and third-floor slab are in final position in one of the wings. Brick for curtain walls is stacked on slab and rides up with it. From hydraulic lifting jack at top of each column, two threaded lifting rods extend down to collar of slab.



With all slabs for one wing lifted into final position, 3-ft gap at center is ready to be formed and filled with concrete to make monolithic slab.

Finding depth of footing for a pole subject to lateral load

IVAN M. NELIDOV, M. ASCE, Civil and Structural Engineer, San Francisco, Calif.

The problem of a pole or tower subject to lateral load at its top, and having its footing fixed in the ground, is a challenging one to solve by nomograph. Consider a pole of height H with a lateral force acting on its top, as shown in Fig. 1 (upper right). The depth of the footing is X and its width is B. The distribution of reactions in the ground is taken as parabolic on the upper two-thirds of the depth of the footing and triangular on the lower one-third. (See *Soil Mechanics*, by D. P. Krynine, 1941, p. 336.)

In checking an existing footing, there are two unknowns, f_1 and f_2. In the design of a new footing there are also two unknowns, f_1 and the depth of the footing, X. Two equations, for Σx and Σy, supply the means for solution.

In our case, $\Sigma x = 0$ or

$$W_p + 0.167\ X\ f_2 B - 0.444\ X\ f_1 B = 0$$

$\Sigma y = 0$ or

$$W_p H + 0.148\ X^2 f_1 B - 0.148\ X^2 f_2 B = 0$$

After solving these equations simultaneously for checking, we find

$$f_2 = 10.8\ \frac{W_p(H + 0.333\ X)}{X^2 B}$$

and $f_1 = 0.333\ f_2$

For design, we substitute in the above equation for f_2 the expression for maximum passive allowable resistance,

$$f_{2a} = w_e \tan^2 (45 + \frac{\phi}{2})\ X$$

which results in a cubic equation for X, that is,

$$0.0925\ w_e \tan^2 (45 + \frac{\phi}{2})\ BX^3 - 0.333\ W_p X - W_p H = 0$$

where w_e is the unit weight of the soil and ϕ is its angle of internal friction.

With $w_e = 0.100$ kips per cu ft, and $\phi = 33° 41'$, this equation becomes

$$0.0327\ X^3 - \frac{W_p}{B}\ 0.333\ X - \frac{W_p}{B} = 0$$

from which the curves of the nomograph in Fig. 1 are plotted.

Example for design

Given: $W_p = 0.300$ kips; $H = 15$ ft; $B = 1.0$ ft;

$$f_{2a} = 0.100 \tan (45 + \frac{33° 41'}{2})\ X = 0.353\ X$$

Solution: From the curves of Fig. 1, we find that $X = 5.30$ ft for

$$\frac{W_p}{B} = \frac{0.300}{1} = 0.300$$

$$f_1 = \frac{0.353}{3}\ 5.3 = 0.62 \text{ kips per sq ft}$$

$$f_{2a} = 0.353 \times 5.3 = 1.87 \text{ kips per sq ft}$$

If $B = 1.67$ ft, then for $\frac{0.300}{1.67} = 0.18$, we find from the curves, $X = 4.5$ ft.

Example for checking

Given: $W_p = 0.35$ kips, $H = 19$ ft; $X = 5.5$ ft; and $B = 2.5$ ft.

Solution:

$$f_2 = \frac{0.35\quad (19 + 0.333 \times 5.5)}{5.5^2 \times 2.5}\ 10.8 = 1.05 \text{ kips per sq ft}$$

$$f_1 = 0.333 \times 1.05 = 0.45 \text{ kips per sq ft}$$

The allowable soil pressure at depth X, or 5.5 ft, is

$$f_{2a} = 0.100 \tan (45 + \frac{33° 41'}{2})\ 5.5 = 1.94 \text{ kips per sq ft}$$

Therefore the footing is satisfactory.

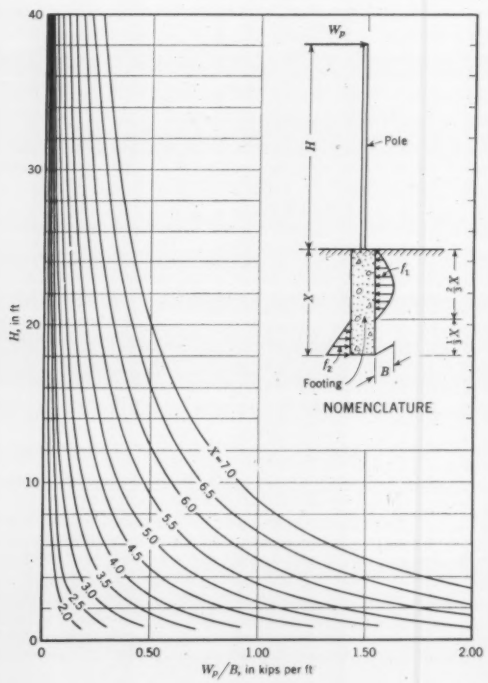


FIG. 1. Curves give depth of footing required for a pole subject to lateral load.

Electronic bore-hole camera for TV projection

KLAUS JOHN, Senior Engineering Analyst
Dames & Moore, Soil Mechanics Engineers, Los Angeles, Calif.

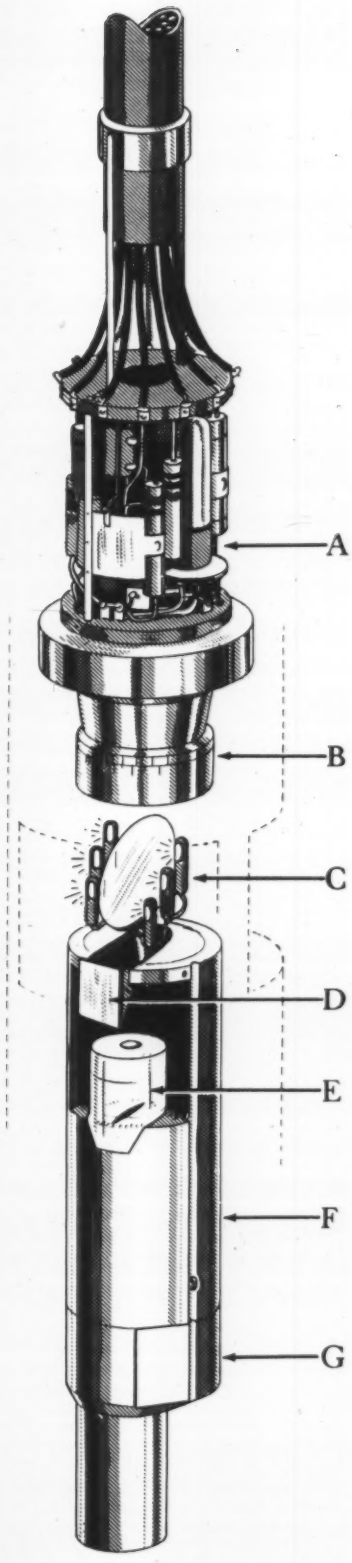


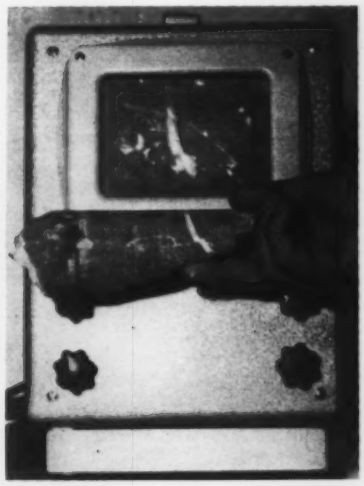
FIG. 1. (Right) Interior of camera part of B 300 shows: A, Grundig electronic camera with transmitter; B, Kern lens; C, rotating mirror with illumination device; D, prism; E, spirit level with compass; F, bearing of mirror axle; G, motor and transmission. Drawing by K. O. Eckland, Los Angeles, Calif.

Closed-circuit television for visual observation in small-diameter bore holes has been developed in Europe and is now available for use in this country. A recently perfected bore-hole telescope, the B 300, will operate to a depth of 1,000 ft, in water if necessary. The camera part of the B 300 is shown in an accompanying photograph. Its diameter of 2½ in. allows it to be used in 3-in.-diameter borings.

In the lower half of the tube is a plexiglass-covered cylindrical view window. Through this window, a wall area of 2-in. diameter (in a 4-in. boring) is reflected by an eccentrically rotating mirror into the Grundig miniature TV camera. A wide-angle 8-mm movie camera lens gives a range of well-focused clearness from the window up to more than 10 in. away. On each side of the mirror three miniature bulbs are mounted to illumine the field of view. Both the mirror and illumination device are remote controlled. In addition, the bulbs can be switched to get different shadow effects. The readings of a compass and a spirit level are reflected into the view area of the electronic camera to give the position of the camera body.

The camera part of the instrument is connected with a TV set at the surface by an electronic transmission cable. In addition a wire-rope line is used to control the depth below grade of the view field and to give a dependable line for pulling, in case of caving of the boring walls.

The electronic equipment and a TV screen (7 to 21-in.), together with other devices such as the mirror, illumination controls, camera moisture gage and generating set, are built into a Volkswagen station wagon. This pro-



Camera part of B 300 is pointed out by Dr. Leopold Mueller (at left), who developed the instrument. At right, rock core is compared with picture on 7-in. screen of B 300. Photos by Keystone, Munich, Germany.

vides a protected and mobile observation shelter. The cables with drums, guiding device, depthometer, and winch are transported separately. It is possible to start bore-hole exploration with a B 300 within half an hour after reaching the site. Usually a trained engineering geologist accompanies the outfit to observe and to record. An experienced assistant handles the cable guide device with the depthometer.

Optical qualities of an under-water picture are almost undisturbed if the sediment is allowed to settle. It is impressive to see on the screen small rock fragments floating in the ground water hundreds of feet below the surface. The illumination control device, permitting changes in intensity and direction, and the shadow markings of the gage lines, allow good determination of the character of the rock in place.

Surveying of subsurface rock can also be carried out by the B 300. Width of faults, impossible to obtain by simple core borings, can be measured directly on the enlarged screen picture. All geological planes are shown in proper polar coordinates. Joints, faults and changes in dips and strikes can be identified exactly from one boring by viewing the screen picture.

The bore-hole telescope B 300 has been used successfully for more than a year on several important jobs in Europe. It was developed by Dr. Leopold Mueller, of Salzburg, Austria, working with Dr. Winfred Pétri, of Munich, Germany, and Grundig-Radiowerke, Furth, Germany, with the assistance of John Keller, drilling and foundation contractor, of Frankfurt, and Ruhrtalsperren-Verein, Essen, Germany. It is now available in this country through the writer, Klaus John, Apt. 3, 407 S. Union Drive, Los Angeles 17, Calif.

A 62-foot prestressed concrete sewer bridge

ARTHUR W. SWEETON 3rd, M. ASCE, Chief Engineer, The Metropolitan District, Bureau of Public Works, Hartford, Conn.

A prestressed reinforced-concrete beam, similar to those currently being used in highway bridges, has recently been adapted to carry a sewer over a stream in the Metropolitan District sewer system of Hartford, Conn. In the past such structures in the District have usually taken the form of "inverted" siphons under the stream bed or of short-span bridges with pier spacing limited to about 15 ft to support 16-ft lengths of ordinary reinforced-concrete sewer pipe.

Highway bridges made up of an assembly of hollow prestressed concrete beams, as described in the technical press including CIVIL ENGINEERING, generated the idea of adapting an individual beam of this type for use as a sewer bridge. It was felt that by this means span lengths might be increased greatly; sewers could be carried across some streams at grade rather than under the stream; sewer cleaning costs might be reduced where inverted siphons could be avoided; a long single-span sewer bridge might cost less, complete and in place, than a sewer bridge with a number of spans on piers, or less than an inverted siphon with special end manholes; and one span without piers would offer less resistance to flood flows.

An inquiry addressed to a supplier of prestressed beams revealed that such a beam (as to their knowledge) had never been used to carry sewage. However they saw no reason why it could not be so used and they offered to assist us in planning such a bridge on the proposed Northwest Trunk Sewer to cross Piper Brook in Newington, Conn.

The District awarded the construction contract for the Northwest Trunk Sewer, including the sewer bridge, to the low bidder, who in turn ordered the prestressed sewer bridge from the beam supplier quoting them the lowest price. Design computations and shop drawings were worked out by the beam supplier and reviewed and approved by the District and its own consultant.

The beam was made 65 ft long overall, giving a clear span between abutments of about 62 ft. See Fig. 1. In our sewer bridge, the circular void in the center was formed with 24-in. asbestos-cement sewer pipe (Johns-Manville Transite), which was supported in the beam form slightly above the center of the beam. The several 13-ft lengths of pipe were not joined with the conventional external

Completed sewer bridge spans Piper Brook in Newington, near Hartford, Conn.

couplings because of the possible weakening effect on the beam. Instead, pipe ends were butted together and lapped with tar paper. Prestressing wires and reinforcing are shown in the accompanying cross section. Bell end forms were used in the beam ends to receive the spigot ends of conventional reinforced concrete sewer pipe with flexible rubber joints.

Design of the prestressed beam was based on the following:

Dead load, weight of beam and asbestos-cement pipe
Vertical live load, pipe full of water plus 50 lb per sq ft of additional live load
Transverse live load, 133 lb per sq ft (stream flood flow)
Buoyancy (with no water in the 24-in. pipe) considered as it affects design of beam
Vertical deflection, not more than 2 in.
Horizontal deflection, not more than 1 in.
Minimum concrete strength, 6,000 psi at 28 days
Minimum tendon strength, 250,000 psi ultimate
Initial prestress, 175,000 psi
Initial prestress, 14,000 lb per ⅜-in. round tendon
Maximum camber after installation, not to exceed 1½ in.

Actual casting of the beam at the supplier's plant in Kenvil, N. J., was observed by representatives of the beam supplier and the District. After proper curing, as determined by tests on concrete cylinders made of the same concrete and cured in the same way, the beam was delivered to the job site by truck and special trailer. Special routing arrangements were necessary to get such a long load over state highways, city streets, and bridges.

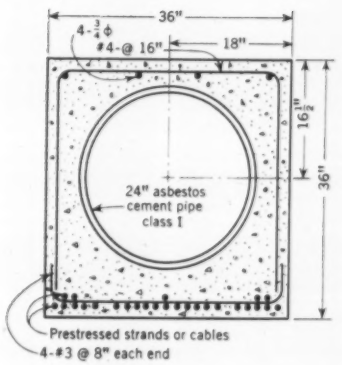


FIG. 1. Typical section shows 24-in. asbestos cement sewer pipe encased in prestressed precast concrete beam.

The 30-ton beam was lifted and set in its final position on graphite asbestos pads on each abutment using two cranes, one at each end of the beam. Four special anchorage assemblies had been cast into each end of the beam to hold temporary eye bolts for lifting. The beam supplier took great care in, and provided special supervision for, lifting of the beam from the casting bed and moving it to final position on the abutments so as to avoid any dangerous reversal of stresses.

The Northwest Trunk sewer project and the sewer-bridge beam were planned and designed by members of the engineering staff of the Metropolitan District, Bureau of Public Works, Hartford, Conn. Valued assistance in beam design and specifications were received from the Bureau's consultant, Robert W. Loomis, J.M. ASCE, Windsor, Conn., and from Robert B. Benscoter, Chief Engineer of Concrete Products of America, Division of American-Marietta Co. of Pennsylvania, Pottstown, Pa., the sewer-beam supplier. The general contractor for the Northwest Trunk sewer contract, including the sewer bridge, was Guerrera and Mancini, Inc., West Hartford, Conn.

Watertight jointing at each end, between the bridge sockets and the adjacent sewer spigots, was accomplished with a Lock Joint pipe "flexible rubber" joint of the sort used in adjacent sewer joints. This joint provides for some flexibility and some expansion and contraction of the bridge beam. If greater beam length, or greater potential temperature changes had required, a watertight joint with still greater flexibility could have been used.

THE READERS WRITE

An important and neglected aspect of design

To the Editor: The discussion of intuition in structural design by Prof. Bruce Johnston, in the November 1957 issue, deserves a great deal of consideration from structural engineering teachers. I believe that Professor Johnston is emphasizing an art which we call here qualitative analysis.

We keep repeating for the students' benefit the statement that a person who can't do *qualitative* analysis and design can't do *quantitative* analysis and design. We try to show the meaning of this statement, both by example and principle. All the structural staff will admit, however, that we are not doing a good job. Maybe this is one of the compartments of design to which the door can be opened only by the key of experience. Even if that is so, we teachers must keep trying.

I hope that other readers will contribute for your pages any ideas they have on the subject. It is one of the more important aspects of design, which has been neglected. A good illustration of this weak spot in our teaching is the fact that Professor Johnston mentioned only two men who have made contributions on the subject. I could add no name to this short list, but I do know that it has been mentioned many times in the corridors. It should be brought to the floor of the house.

D. M. McCain, M. ASCE
Head, Dept of Civil Eng.
Mississippi State College
State College, Miss.

Who first introduced logarithmic paper?

To the Editor: The statement in Do You Know That (November issue, p. 43) that "Log paper may have been developed by the late John R. Freeman

. . . (in) March 1894" invites comment.

W. F. Durand, one of the most distinguished members of the engineering profession in this country, born March 5, 1859, was the man who first introduced logarithmic paper—in 1892. This fact is mentioned in his excellent autobiography, *Adventures—in the Navy, in Education, Science, Engineering, and in War; a life story* (ASME and McGraw-Hill Co., 1953).

His article, "The Use of Logarithmic Cross-Section Paper," was published in 1893 (*Engineering News*, Vol. 30, No. 13, Sept. 28, 1893, pp. 248-251). Dr. Durand, an Honorary Member of ASME, is Professor Emeritus of Mechanical Engineering, Stanford University.

This information is offered without the slightest intention of detracting from the merits of the illustrious John R. Freeman. I wish only to pay tribute to another great American pioneer in engineering.

STEPONAS KOLUPAILA
Professor of Civil Engineering
University of Notre Dame

Notre Dame, Ind.

Nomograph for pole subject to lateral load

TO THE EDITOR: In my work I often encounter problems involving a pole or tower subject to lateral load at its top and having its footing fixed in the ground. Therefore I read with interest the article by Noble G. Robbins, "Piers Supported by Passive Earth Pressure," in the April 1957 issue, p. 70.

When recently I had a chance to use this material and started to read it carefully, I found several confusing features. First, there is no indication as to what theory or assumption the distribution of earth resistance is based on, and therefore there is no way of checking the formula presented for the difference between total passive and total active earth pressure.

Second, the formula given for passive resistance, P_p, is actually not for total passive resistance but for resistance per foot of depth. Third, the equation from which the relationship between H, X, and W_p is derived, is not independent of B, the width of the footing, and therefore should be plotted in terms of W_p/B, rather than of W_p only. This does not lead to confidence in the plotted nomograph.

These considerations prompted me to prepare my own curves for the terms involved. [See article by Mr. Nelidov in the Engineers' Notebook section of this issue, p. 66.]

IVAN M. NELIDOV, M. ASCE
Civil and Structural Engr.

San Francisco, Calif.

Additional information on a Mexico City skyscraper

TO THE EDITOR: Your October and November issues contained two reports on the Mexico City earthquake of 28 July 1957, by J. H. Thornley, M. ASCE, and Pedro Albin, A.M. ASCE. The authors are to be commended for collecting detailed information on 46 structures, and for presenting it in such a manner as to make it easily understood.

Some additional information on the Torre Latino Americana office building may help to explain its excellent performance during the earthquake. In December 1954, I was in Mexico City and visited this structure in company with Dr. Leonardo Zeevaert, A.M. ASCE, who was the general consulting engineer on the foundation and superstructure. During the visit we met Adolfo Zeevaert, A.M. ASCE, who was director of construction and chief engineer on "La Latino Americana."

Much of the credit for the successful construction of this skyscraper and its performance thereafter must be given to the Zeevaert brothers. Construction of the basement to a depth of 44 ft below the ground surface, and 41 ft below the water table, was a difficult task and presented many engineering problems. It was a real feat to excavate this area under such conditions without causing settlement of adjoining buildings. This could not have been achieved without the careful investigation and testing of the foundation materials during the design stage by Leonard Zeevaert.

Also, to erect the 43-story superstructure was a great accomplishment in a land where skyscrapers are not often built. Adolfo Zeevaert, who had an office in the building, personally inspected every construction operation, and his close supervision resulted in a much better structure.

In this age of electronic computing machines there is a tendency to reduce engineering to punch marks on a card. The lesson that Torre Latino Americana brings to our age is that engineering is still a personal art that requires the first-hand attention of a dedicated, trained individual.

CLAUDE A. FETZER, J.M. ASCE
Chief, Soil Design Section,
U.S. Engineer District,
Los Angeles

Los Angeles, Calif.

Ratios of cost increase in past 26 years

TO THE EDITOR: Catching up on back issues I missed during the summer vacation, I read with interest the article in the July issue, "Construction Begins on Glen Canyon Dam." In it Mr. Dexheimer pointed out that costs have approximately tripled in the 26 years since the construction of Hoover Dam. Using the figures he gave in the article, the ratios of increase of certain costs were as follows:

Common labor	4.5
Skilled labor	4.6
Cement	2.5
Steel	3.5

As I recall, the starting rate for a graduate engineer in the early thirties was the old P-1 rating, which paid $2,000.00 per year. At the present time, the Federal Government has notices on our bulletin board offering graduate engineers a rating of GS-5, paying $4480.00 per year. This represents a ratio of increase of 2.2 in some 25 years.

Did someone say something about a shortage of engineers?

MARVIN CLARK MAY, M. ASCE
Professor of Civil Eng.
Univ. of New Mexico

Albuquerque, N. Mex.

Hvorslev sampler credited to Corps of Engineers

TO THE EDITOR: I have read the excellent article, "New Sampler Speeds Design of 31,000,000-Cu Yd Fill" on the Great Salt Lake Crossing, by H. V. Anderson, in the December 1957 issue.

An error relative to the Hvorslev piston sampler appears in the upper part of Column 3, page 42. This piston sampler was developed by Jules Hvorslev under the auspices of the Waterways Experiment Station, Corps of Engineers, rather than by the Bureau of Reclamation. The equipment we are using in the Bureau is essentially the same as the Waterways Experiment Station's Hvorslev sampler, with a few minor modifications.

WESLEY G. HOLTZ, M. ASCE
Chief, Earth Lab. Branch
U. S. Bur. of Reclamation
Dept. of the Interior

Denver, Colo.

SOCIETY NEWS

Portland Convention to Feature Columbia Basin Water Resources

The Oregon Country—specifically the historical Willamette Valley—will be the setting for the next ASCE Convention, slated for Portland, June 23-27. The water resources of the vast Columbia Basin will be a focal point for discussion in the five-day program, in which most of the Society's fourteen Technical Divisions will take part.

With a large concentration of rock-fill dams in the area, there will be a comprehensive symposium devoted to this type of structure and a field trip to Swift Creek Dam—highest rock-fill dam in the world—which is under construction. Two other rock-fill projects—Brownlee and Hill's Creek dams—are also under construction in the area.

To think of Oregon is to think of forests and lumbering. So wood naturally will be the subject of several technical sessions, with emphasis on its versatility as a structural material and upon new structural uses. A supplemental field trip has been arranged to the Weyerhauser and Long Bell lumber and pulp plants at Longview, Wash., center of the world's largest lumber operations.

Of interest also will be a tri-county approach to solving the perennial problem of sanitary waste disposal for a metropolitan-suburban area.

Conditions of Practice Program

In the three scheduled Department of Conditions of Practice sessions (one of them a luncheon), the spotlight will be on professional unity—can all engineers get together and how? The discussion will include attention to such aspects of professionalism as engineering education, teaching as a profession, and public relations for the engineer.

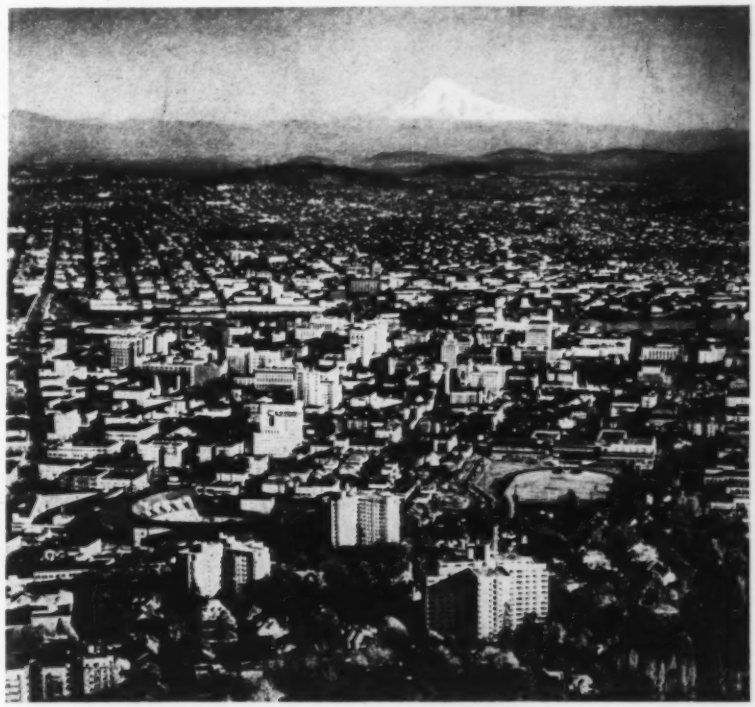
Bring the Whole Family

Oregon Section committees in charge of arrangements are urging members to make a holiday of the Convention and bring their families along. Portland—famed as the City of Roses—is at its best in June. Still more important for the vacationing family, it is in the heart of some of the most rugged and beautiful country in the United States. The special ladies' program will feature a luncheon at Timberline Lodge, at the foot of famous Mt. Hood. Here there will be a fashion show, with emphasis on outdoor wear of all kinds. The Timberline Lodge trip will also take in the Government Camp and Ski-Bunny Lodge. Among the other parties planned for the women visitors is a Get-Acquainted Brunch at the Aero Club of Oregon. Monday evening all will get acquainted at a dinner and party—"Family Chuck Wagon, Western Style"—to be held at El Rancho, fifteen miles west of Portland.

Complete Program in May

A better idea of the wide choice of technical and social events in store for Portland Convention visitors will be given in the full technical program, which will be published in the May issue.

H. Loren Thompson is general Convention chairman, and F. Stewart Brown vice-chairman. On their Advisory Committee are Oregon Section President Charles Craig, John W. Cunningham, Robert Hickson, Glenn W. Holcomb, and Jack C. Stevens.



Snow-capped Mt. Hood rises 11,245 ft to form a majestic background for Portland. The Willamette River meanders through the heart of the city. Beautiful homes and gardens have earned for Portland the title, "City of Roses." Photo courtesy, Portland Chamber of Commerce.

Hawaii Section to Be Host to Post-Convention Tour

Headquarters hotel—the Hawaiian Village—is located on beautiful Waikiki Beach. It offers 600 tasteful rooms and suites, plus a variety of restaurants, specialty shops and night clubs. Of special interest to engineers is its Dome Convention Hall with facilities for 2,000.

The fortunate Convention visitors who decide to take advantage of the Hawaii Section's invitation to a Post-Convention Tour of the Islands will take off from Portland by air as soon as the Convention is over. To make sure that no one is disappointed, space is being held on Northwest Airlines flights leaving Portland 11:40 p.m. on June 27 and 10:55 a.m. on June 28. Both flights are tourist class, and special attention will be given to Convention groups.

Technical sessions, to be held in Honolulu, July 1 and 2, will precede the tour. These sessions are being drawn around the highway problem, which is as acute in Honolulu as in most other communities today. Shut in by mountains and the sea and faced with a burgeoning population in the past few years, Honolulu has a growing residential area on the northern shore of the Island. This area is separated from the main business section of the city by a mountain range, which is crossed by only a two-lane highway. Within the next two years this highway will be replaced by two tunnels, each carrying four lanes of traffic. One of these projects, the Wilson Tunnel, will be discussed by Dr. Ralph B. Peck. Soil mechanics experts in the Territory will present a panel discussion on the unique soil problems to be solved in building the approach roads to these tunnels, which traverse areas with an average annual rainfall of more than 100 inches.

The over-all Territorial highway program will be discussed by William Wachter, superintendent of public works for the Territory. Side trips to highway and other interesting local projects will supplement the technical programs. The Section has designated Trade Wind Tours of Hawaii to coordinate and assist in the operation of the tour. Hawaii laws and the limited hotel accommodations available make it almost imperative to have travel arrangements, hotel reservations, and sightseeing trips booked well in advance. Trade Wind Tours, with the cooperation of mainland travel agents, has prepared a comprehensive brochure of available trips both on Oahu and neighboring islands. This brochure has been made available to presidents of Local Sections, who will be glad to put members in touch with the travel agent nearest them. The Section urges members to make use of these designated agents to assure the success of their trips.

The Hawaiian Village, the Island's most complete convention hotel, has been designated the headquarters hotel, and accommodations for mainland visitors are being held there.

As an example of the tour rate structure in the Islands, Tour "A"—priced at $117.14 for one person sharing a double room—includes nine nights at the Hawaiian Village, all social activities, and sightseeing trips on the Island of Oahu. Ten- and eleven-day tours covering some of the other islands are also available.

Papers from Prestressed Concrete Conference

An up-to-the-minute collection of information and experience in the prestressed concrete field—presented at the recent World Conference on Prestressed Concrete in San Francisco—is now available in the Proceedings of the Conference. The 600-page Proceedings consists of 64 papers, the work of engineers all over the world.

All who remember the scope of the World Conference will want to see the Proceedings, which may be purchased at $10 a copy (including postage). Inquiries should be sent to the World Conference on Prestressed Concrete, Inc., Room 216, 417 Market Street, San Francisco 5, Calif.

ASCE QUARTERLY ENGINEERING SALARY INDEX

Consulting Firms

City	Current	Last Quarter
Atlanta	1.11	1.11
Baltimore	1.11	1.10
Boston	1.13	1.13
Chicago	1.26	1.12
Denver	1.19	1.14
Houston	1.08	1.08
Kansas City	1.14	1.11
Los Angeles	1.16	1.16
New York	1.17	1.17
Pittsburgh	0.93	0.91
Portland	1.15	1.15
San Francisco	1.18	1.21
Seattle	1.07	1.07

Highway Departments

Region	Current	Last Quarter
I, New England	0.88	0.88
II, Mid. Atlantic	1.15	1.12
III, Mid. West	1.24	1.19
IV, South	1.02	1.05
V, West	0.96	0.96
VI, Far West	1.15	1.12

Figures are based on salaries in effect as of Nov. 15, 1957. Base figure, the sum of Federal Civil Service, G. S. Grades 5, 7, and 9 for 1956, is $15,930.

Society Supports Federal Salary Revisions

ASCE has taken action in support of measures designed to remove "inequities" in the Federal Classification Act, particularly in regard to the grade and salary schedules of the professional and scientific employees in Federal Civil Service. The Society has also recommended interim salary adjustments for professional engineers in the Uniformed Services that will be comparable to those recommended for Civil Service engineers.

These actions were taken in resolutions passed by the Society's Committee on Engineers in Public Practice, and implement a previous action of the Board of Direction, which voted in June 1957 to "endorse the Cordiner Committee recommendations in principle."

The first resolution stated that ASCE has been cognizant in recent years of inequities in the present Federal Classification Act concerning the grades and salaries of professional and scientific employees of the government, and pending further study thereof:

"The American Society of Civil Engineers particularly endorses the pay schedule as recommended by the Administration and strongly recommends the passage of legislation by the current session of Congress embodying substantially the recommendations of the Administration and the Cordiner Report."

It further stated that the Society strongly endorses the establishment of a Joint Commission, composed of congressional, executive and public members, to undertake a thorough revision of the present Classification Act compensation system, as recommended by the Cordiner Committee.

The second resolution recognizes that the salaries of professional engineers in the Uniformed Services of the United States are not comparable with those paid elsewhere to people in similar positions and occupations, and that the provisions for salary advancement are not commensurate with the rate of salary growth in private practice.

The resolution states, "The American Society of Civil Engineers, although recognizing the need for further study of all facets of uniformed personnel problems, strongly urges interim salary adjustments for professional engineers in the Uniformed Services that are comparable to those recommended for engineers in the Federal Civil Service."

It also stated that if remedial changes are not made, "professional standards in Governmental activities cannot be adequately maintained nor can properly qualified professional engineers be induced to enter or to remain in the Uniformed Services for extended periods, with resulting detriment to the security and economy of the nation."

1958 Nuclear Congress Papers Available

In this period of exploration, the forthcoming 1958 Nuclear Congress is of special importance. The Congress, the fourth such meeting, is sponsored by the American Nuclear Society and over thirty national engineering and scientific societies. Coordinated by Engineers' Joint Council, it will be held this year, March 17-21, at the International Amphitheatre in Chicago.

Preprints of papers presented at the conference may be obtained from the Congress Manager, the American Institute of Chemical Engineers, 25 West 45 Street, New York 36, N. Y., for 50 cents. Some of the groups are of particular interest to civil engineers. Under the head of Health Physics and Instrumentation, there is a paper by W. H. Truran on "Trends in Radiation Protection with Nuclear Reactors."

Five papers on Waste Treatment and Disposal also merit attention. They are "Geological and Hydrologic Guides to the Ground Containment and Control of Wastes at Hanford," by R. E. Brown and W. H. Bierschenk; "Treatment of Radioactive Wastes Using Ion Transfer Membranes: Removal of Bulk Electrolytes," by E. A. Mason, E. J. Parsi, and A. J. Giuffrida; "Special Considerations in the Design of the Waste Disposal Plant for the Shippingport Reactor," by J. R. LaPointe, J. V. A. Longcour, W. R. Kennedy, and W. T. Lindsay, Jr.; "Radioactive Liquid Waste Disposal from the Dresden Nuclear Power Station," by C. F. Falk; and "Treatment of Liquid Radioactive Wastes—European Practice," by Conrad P. Straub.

Under Reactor Location and Safety, "Health Physics for an Urban Nuclear Facility" is discussed by J. W. Baum. Three authors give their views on Progress in Commercial Power Reactor Development. Papers presented are "Design of Power Plant for the First Nuclear Merchant Ship," by R. L. Whitelaw; "Developments in Commercial Atomic Power Plants," by G. H. Farbman; and "The Consolidated Edison Nuclear Electric Generating Station," by O. G. Hanson and F. R. Ward.

Nuclear Education and Training is discussed by Glenn Murphy, W. Kenneth Davis and Saul J. Harris. Their papers are "Relationships Between the Universities and Industry in Nuclear Engineering"; "Relationship Between Industry and Government"; and "Nuclear Training Programs for Industry."

A final category is authoritatively handled by five well-qualified men. Papers under the head, Reactor Shielding and Containment, are: "Thermal Considerations in the Design of Concrete Structures for Shielding Atomic Power Plants," by Harold S. Davis; "Civil Engineering Aspects of the Dresden Nuclear Power Station," by Joseph E. Love, Chester S. Darrow, and Burr H. Randolph; "Reactor Shield Calculations," by W. E. Edwards; "Design of ERB-II Primary Tank Support Structure," by R. W. Seidensticker and S. H. Fistedis; and "Containment-Vessel Design Basis for the Dresden Nuclear Power Station," by G. Sege.

ASCE Manual on Sewage Treatment Plant Design

A committee of the ASCE Sanitary Engineering Division has been working several years, in cooperation with the Federation of Sewage and Industrial Wastes Associations, to produce a Manual of Practice on Sewage Treatment Plant Design. Before final acceptance and publication of the Manual, the Board of Direction will appreciate having the critical comments of interested members. A limited number of manuscripts are available for such review and may be borrowed for a period not exceeding two weeks, with the Society paying all postal charges. Comments may be mailed to ASCE Headquarters until May 15, 1958.

Some idea of the contents and scope of the proposed Manual may be obtained from the twenty-one chapter headings: Basic Design Considerations; General Plant Layout; Plant Pumping Stations; Screening of Sewage; Grit Removal; Flotation Units; Flocculation of Sewage; Sedimentation Units; Chemical Precipitation; Activated Sludge; Trickling Filters; Miscellaneous Aerobic Biological Treatment Units; Sludge Pumping; Sludge Digestion; Sludge Dewatering and Disposal; Chlorination of Sewage; Chemicals; Service Buildings; Miscellaneous Design Considerations; Materials and Construction Requirements; and Design for Safety.

Library—Key Asset of New United Engineering Center

This is scene at cornerstone laying for Engineering Societies Building in New York on May 6, 1906. Building was occupied in December of that year and dedicated in April 1907. Three stories were added (and two of them occupied) by ASCE in November 1917. Participants in the ceremony identifiable after half a century are (1) Judd E. Wells, of Wells Brothers & Co., who built the original Engineering Societies Building and ten years later added three floors for ASCE; (2) Frederick Winslow Taylor, president of ASME, 1906; (3) James Mapes Dodge, president of ASME, 1903; (4) Andrew Carnegie, ironmaster and philanthropist and donor of headquarters building; (5) Miss Margaret Carnegie, now Mrs. Carnegie Miller; (6) Rossiter W. Raymond, a founder of AIME; (8) Mrs. Andrew Carnegie, who laid the cornerstone; (9) John Fritz, Hon. M. ASCE, who established the John Fritz Medal in 1902; and (10) Charles Hays Haswell, consulting engineer, aged 97 when photo was taken.

A young woman, a research assistant to an engineer, dropped into the Engineering Societies Library at Society Headquarters in New York City one day in 1956, and asked permission to do some research on geology. Two years later, in 1958, she is still at her task, after spending nearly every day of that period delving into the vast amount of engineering material that the Library offers.

A group of research men spent several months in the Library correlating published information on nuclear energy.

Intermittently over the past five years, a company involved in a long-drawn-out patent suit has had one or two people examining original sources.

These are only some of the unusual uses that have been made of the Engineering Library, which may or may not be the largest library in the world devoted to engineering subjects, depending on the validity of certain foreign claims. If it isn't, it certainly is the best documented and best indexed of any engineering library anywhere.

Founded just 45 years ago, through the generosity of Andrew Carnegie, the Library will be the outstanding asset of the new United Engineering Center—a $10,000,000 structure to be erected in New York City on a site adjacent to the United Nations Building. This will be the headquarters of 20 or more of the national engineering societies and associations. To help defray the cost of the new building, ASCE members and members of other societies are being asked to make voluntary contributions.

Right now the Engineering Societies Library is one of a group of related engineering organizations which coordinate their information activities to provide services used by engineers and technologists throughout the world. The group includes the four engineering societies, known as Founder Societies which, through the United Engineering Trustees, Inc., maintain the Library. Also included is the Engineering Index which cooperates closely with the Engineering Societies Library.

Once the move is made to the new United Engineering Center, the Library probably will be the information center for engineers and technologists for all the societies with headquarters in the building. As a matter of fact, the shelves of the present Library burgeon with information covering all branches of engineering. It has 175,000 volumes, 20,000 maps, 5,000 translations, 1,400 current periodicals and many thousands of bibliographies and indexes.

The roots of the Engineering Societies Library are in the early libraries of the Founder Societies—the American Society of Civil Engineers, the American Institute of Mining, Metallurgical and Petroleum Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

The Societies, founded in the years from 1852 to 1884, started their own separate collections of books soon after their founding. None of these collections in their early days could truly be called libraries, however, for they were largely unindexed and uncatalogued. Even so, the collections were useful and valuable, and from them the present Library grew to its sturdy position today.

A history of one of the Societies reports several moves in its early years to acquire more space for its staff and library. One move is recorded as being particularly significant, for improved gas lighting had been installed on the premises, and now its members could read at night.

When the Founder Societies moved into the present building at 29-33 West 39th Street, they placed their separate collections of books adjacent to each other in the reading room on the thirteenth floor of the building. The collections remained separate until 1913, when they were merged under the direction of a trained librarian and a library board, and the relatively unorganized separate collections were combined, organized, and catalogued.

Although it is the library of four engineering societies, its services are generally available to anyone, and are used by engineers, scientists, technologists and industry in this country and throughout the world. However, only

members of the Founder Societies are permitted to borrow books.

The direct services of the Library include a reading room which is open six days and five nights a week. It is much used on Saturdays by engineers who cannot come in during the week because of distance or other reason. During the Christmas and spring vacations many college students, some of them from distant points, spend part of their holidays working on term papers. But more than half the users of the Library do not come to it in person, but use it by mail, telephone, and telegraph.

Literature searches and bibliographies are made to meet the specific requirements of the inquirer. The services range from recommending some books on a specific subject to the preparation of comprehensive annotated bibliographies of books, articles, and reports. Searches are also made for disclosures related to patents, but all search work is kept confidential.

Translations of engineering and technical articles are made from all languages including Russian into good English by consultant translators who are familiar with engineering. There are members of the Library staff who collectively can also read up to a dozen languages, and some member of the staff reviews translations to assure accuracy of translation and the quality of English.

Photoprint and microfilm copies of Library material are made on request, and last year 75,000 photoprints were sent to engineers everywhere.

Requests of all kinds come into the Library, and some are not easy to accommodate.

"Please send me all the books you have on civil engineering," wrote an inquirer.

Ralph H. Phelps, who has been a director of the Library for the past 13 years, can laugh about requests like this, although library work is serious business with him.

"We think we have the best engineering library you can find anywhere," he says. "If we can't answer a request for engineering information, you can be pretty sure that little, if anything, has ever been published on the subject."

A Guide for Our Public Relations Program

M. O. Chenoweth
Public Relations Director, ASCE

ASCE's new public relations program got off to a good start within the past few weeks with the distribution of two publications designed for the use and information of the chairmen of the Local Section and Local Branch Public Relations Committees.

The new publications are:

"ASCE Public Relations Guide," a 40-page booklet with an attractive blue and gray cover, prepared by the Headquarters' Public Relations Department.

"P.R. Bulletin," a mailing piece bearing a blue and black letterhead, also prepared by the Public Relations Department.

The new "Public Relations Guide" is intended to be of help to the Public Relations committees in their efforts to pursue public relations activities in their own localities.

But the Guide, as produced, is purposely directed to those who realize that public relations not only is a desirable but also a necessary function for a Society such as ours.

In short, it is a direct approach to this problem of public relations—without any frills or froth, but with an acknowledgment that any man or woman who can qualify as an engineer also can perform in a public relations capacity, if he puts his mind to it, and if he follows a few simple rules as outlined in the Guide. Copies have been mailed to all local public relations committees.

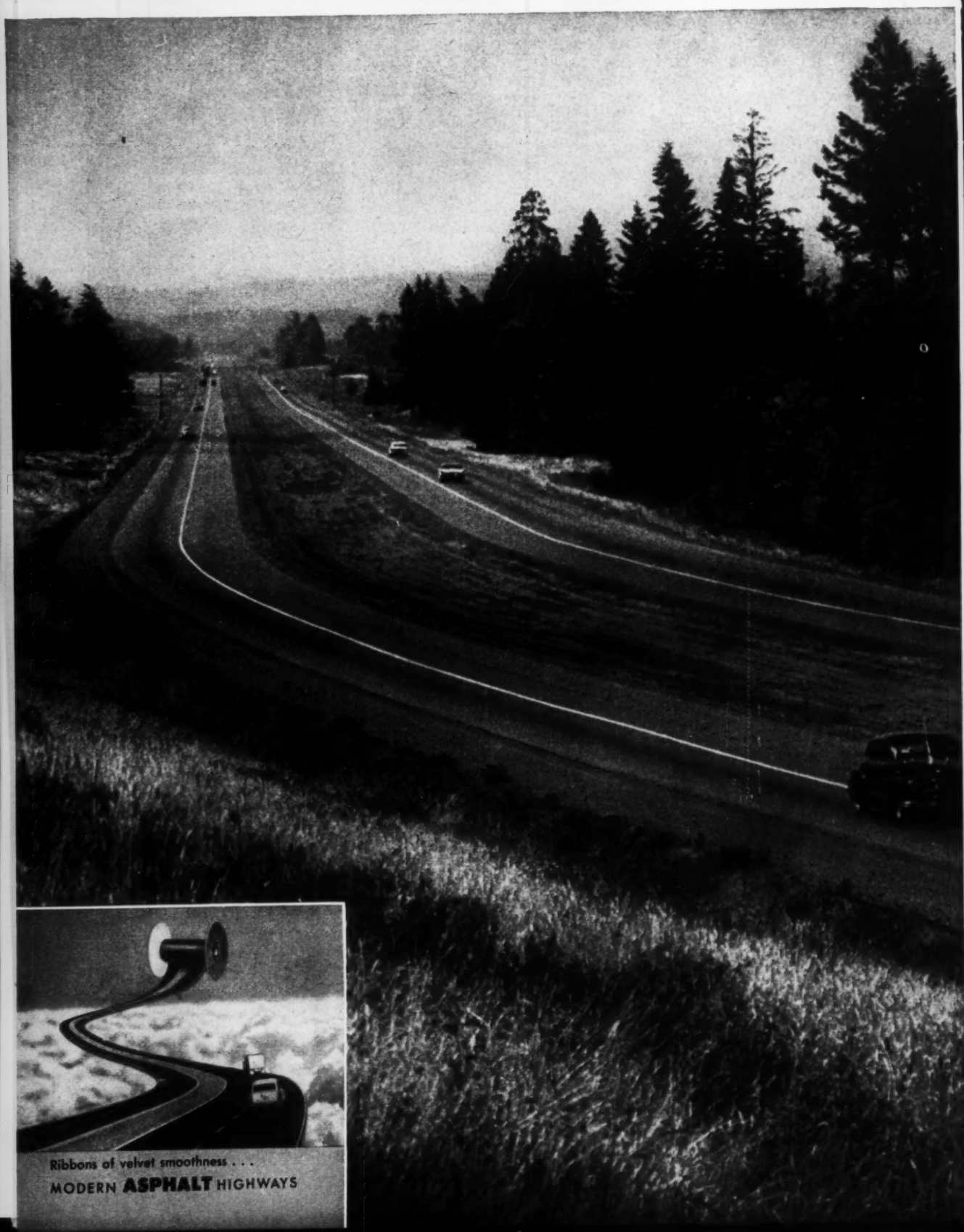
The same thing may be said about another innovation in the accelerated program of public relations for ASCE. This is the "P.R. Bulletin," a one-page mailing sheet that will go from Society Headquarters regularly to the chairmen of the various local public relations committees within the Society. Its purpose is to stimulate and keep alive interest in public relations at the local level, and it offers ideas, suggestions, and case histories of public relations that will afford more effective operations.

The Guide is geared specifically to civil engineers and public relations. Recognizing that a practicing engineer does not have the time, or inclination, to become a public relations specialist, it is mostly concerned with local-level publicity, which can be described as an instrument of public relations. Consequently, it does not attempt to teach or train, but merely to guide the committees in their public relations activities.

There are 12 chapters in the Guide, and their contents can easily be determined by their titles, which are as follows: "The Job of the Public Relations Committee;" "Making Contacts;" "Preparation of Story Material;" "Mailing Lists;" "Types of Stories to Handle;" "Helping ASCE Members on Project Publicity;" "Other Publications;" "Photographs;" "Other Ways to Get Publicity;" "Public Issues;" "Cooperation of Headquarters' Office;" and "Summary of Objectives."

Of these, the chapter referring to cooperation of headquarters' office may be emphasized. Through the Guide and the "Bulletin," attempts are being made to maintain direct ties between the public relations department at headquarters and the public relations committees of the Local Sections and Branches. This will enable us to strengthen and unify our public relations efforts.

Rugged ASPHALT paving saves



Ribbons of velvet smoothness . . .
MODERN **ASPHALT** HIGHWAYS

Washington $30,000 a mile

...Saves State $381,000 in first cost on 12.7 miles of Interstate Highway. Maintenance savings expected, too!

For the Prairie Creek to Tumwater section of U. S. Highway 99, the State of Washington chose modern Asphalt pavement.

By so doing it saved thousands of dollars in initial costs alone. The entire paving cost for 12.7 miles was $826,978 . . . with savings of $30,000 a mile compared with a connecting slab-paved section. *And more savings are to come . . . for Washington's records indicate that Asphalt pavements cost less to maintain.*

As records show in state after state, modern Asphalt highways are not only economical but also rugged and safe.

Rugged . . . because layer-upon-layer construction "locks" surface to the foundation, builds up strength and resilience.

Safe . . . because modern Asphalt pavement is traction-textured for high skid-resistance. There is less glare . . . greater traffic-line visibility.

In winter, snow melts faster and Asphalt pavement is not harmed by de-icing chemicals.

ENGINEERED FOR RUGGED WEAR

Modern Asphalt construction is a triumph of road-building science. Built-up layers spread the load . . . absorb shock and pounding. Economy, safety and comfort are built-in to last.

THE ASPHALT INSTITUTE

Asphalt Institute Building, College Park, Maryland

Site Cleared for United Engineering Center

Demolition of old buildings on site of new United Engineering Center Building (light-colored structure at lower right) has started. The twenty-story tower will face on 47th Street. United Nations Building is at lower left, and Empire State Building at upper left. Chrysler Building is in direct center. Accessibility of new Center to members is illustrated by the fact that the East Side Airlines Terminal is just to the left of the U. N. Building; Grand Central is just behind the Chrysler Building; and Pennsylvania Station is just behind the Empire State Building. Present plans call for groundbreaking next summer. The industrial campaign to raise funds reached 43 percent of its goal with the first 27 contributions.

Division Doings

Hydraulics Division

The Division's Hydromechanics Committee (formerly the Committee on Research) announces that there has been a good sale of its "List of Translations of Hydraulics Literature." Plans to keep the list up to date by publicizing the existence of current translations have been made, with J. C. Tienhoven put in charge of collecting current information in the field. Engineers who know of hydraulics translations made in the past two years are urged to report them to Mr. Tienhoven, who is at the Waterways Experiment Station, Vicksburg, Miss.

Pipeline Division

Pipeline transportation and distribution developments, particularly in the Pacific Northwest, will be featured in the Pipeline Division's program at the Society's Portland Convention. The fifteen scheduled papers will cover the flow of oil products, natural gas, gilsonite slurry and other solids, and water. R. E. Kling is in charge of the Sessions Program.

New committees recently set up in the Division include the Committee on Pipeline Flow, which will be particularly concerned with the flow of petroleum liquids and gases. The recently formed Committee on Pipeline Location is currently summarizing the results of questionnaires sent out to some 100 crude products, gas, and water pipeline companies on existing policies relative to pipeline location.

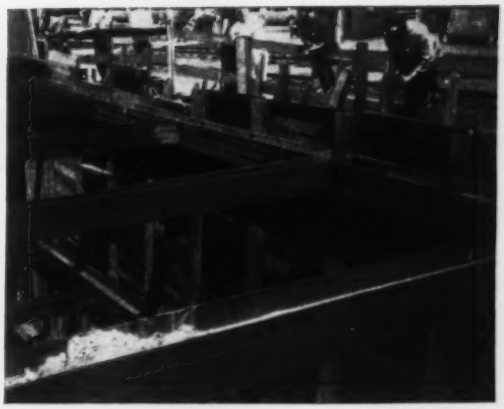
Model of the jet that is creating so many new problems for airport engineers is held by Ronald M. White, director of the Kansas City Aviation Department, at recent meeting of Air Transport Division's executive committee. To his left are John M. Kyle, Jr., chief engineer of the Port of New York Authority; Don P. Reynolds (standing), assistant to the Secretary of ASCE; Division Chairman Robert Horonjeff, professor of transportation at the University of California; Division Secretary Reginald J. Sutherland, airport engineer for American Airlines; and Joseph M. Blatt, deputy regional administrator, CAA, New York.

Sanitary Engineering Division

Prof. I. W. Santry, of Southern Methodist University, is new chairman of the Sanitary Engineering Division's Committee on Publications. He fills the vacancy created by the recent resignation of Dr. Ross McKinney, of Massachusetts Institute of Technology.

Air Transport Division

The purchase of jet airliners by commercial airlines has opened a veritable Pandora's Box of Troubles, the Air Transport Division reports. So many and so varied are the new problems involved in airport construction, operation, and maintenance that the Division took steps at a meeting of its executive committee, on January 17, to pool important information available from the various interests concerned. The Division is planning a Second Jet Age Airport Conference.



Bethlehem H-piles provide lateral support for excavation for railroad tunnel under construction at Salem, Mass. *Contractor:* Farina Brothers Co., Inc.

Construction of Boston's Fitzgerald Expressway included placing of Bethlehem H-piles as soldier beams. *Contractor:* V. Barletta Co.

Soldier beams and bracing support foundation of existing buildings adjacent to new Jordan Marsh Building, under construction in Boston. *Contractor:* Spencer, White, and Prentis, Inc.

Steel H-Piles Used as Soldier Beams on Three Jobs in Massachusetts

For three important construction projects in Massachusetts, Bethlehem H-piles were used as soldier beams in open-cut excavations.

The first job is a portion of the construction of Boston's new Fitzgerald Expressway, a heart-of-the-city superhighway. Here H-piles were driven vertically on the sides of a large open cut during the building of a tunnel and ramps. The piling and its lateral bracing will prevent slides and protect existing foundations and adjacent streets.

Bethlehem H-piles were used in the same way in the construction of the new Jordan Marsh Building in Boston. Here adjacent building foundations were protected by the H-piles together with horizontal timber lagging and lateral braces.

At Salem, Mass., an open cut for a railroad tunnel was also protected by the soldier-beam method. Bethlehem H-piles retained foundations of streets on which traffic continued to move.

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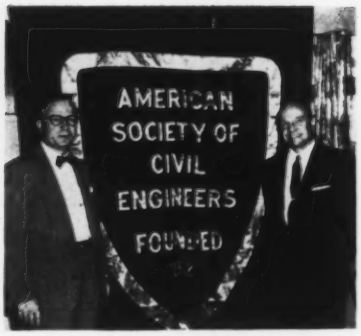
NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

A talk on problems involved in space travel held the attention of **Akron Section** members and guests at the Section's January meeting. Speaker of the evening was Richard Couts, project engineer for Goodyear Aircraft Corp., of Akron, whose authoritative talk roused comment and questions from the floor. New officers for the 1958 season are Alfred R. Seese, Jr., president; Charles E. Cockerham, vice-president; and Norman R. Cox, secretary-treasurer.

The spotlight was on the ladies at the **Central Illinois Section's** January meeting, when Mrs. E. E. Bauer and Mrs. Clyde Kesler reported on recent trips to Mexico. The two ladies, who had accompanied their husbands south of the border in connection with ASTM committee meetings, described their experiences, and showed slides of places visited. Life membership certificates were presented to Prof. Thomas C. Shedd and Jamison Vawter.

Atomic fallout and radiological health problems were discussed by Dr. Frank DeMarinis, chairman of the Fenn College department of biology, at a recent **Cleveland Section** meeting. Dr. DeMarinis divided his talk into four parts—the flash, blast, radiation from blast, and fallout from an atomic explosion. A blast of 20 kilo tons at 6 miles is 100 times brighter than the sun, and can be seen 400 to 600 miles away. Seven thousand feet out of range, the radiation is zero, but about two pounds of radio-active material is sent out to be carried away by winds. The informative talk proved valuable even to those unfamiliar with this side of engineering.



Delaware Section President J. D. Wilson chats with Executive Secretary W. H. Wisely at Section Meeting. Mr. Wisely spoke on Society affairs.

ASCE President Louis R. Howson presents Life Membership Certificates to Illinois Section members at Section's annual banquet. Honored (shown here; in usual order) are: Alvah S. Holway, Ernest G. Waters, Charles S. Pillsbury, Thomas F. Wolfe, John E. Bernhardt, Henry Penn, Lawrence L. Edlund, Charles H. Mottier, and Mr. Howson.

The Mohawk-Hudson Section held its annual meeting in Latham, N. Y. to elect officers for 1958. The slate is (left to right), Haaren A. Miklofsky, second vice-president; Harold B. Britton, retiring president; Erhard E. Dittbrenner, treasurer; Holbert W. Fear, president; and Thomas J. Buchanan, secretary. Cliff S. Barton, first vice-president, was absent when the picture was taken.

Two special guests doubled as speakers of the evening at the January meeting of the **Intermountain Section.** They were R. Robinson Rowe, ASCE Director for District 11, and E. Stuart Kirkpatrick, Assistant to the Executive Secretary. Mr. Rowe talked of the many services offered by the Society, and urged members to join the Technical Divisions and take advantage of the journals available to them. Mr. Kirkpatrick brought members up to date on Society policies. A Life Membership Certificate was presented to O. W. Israelson. Newly installed officers for the 1958 season are Vaughn E. Hansen, president; Preston D. Linford, vice-president; and Warren D. Curtis, secretary-treasurer.

Election returns just in from the **Kansas Section** name Walter F. Robohn president, and C. Frank Virr, vice-president. Dale E. Dugan remains in office as secretary-treasurer.

At the helm of the **Kansas City Section** for the coming year are L. W. Bremser, president; J. F. Daily, first vice-president; R. O. Davis, second vice-president; and R. M. White, secretary-treasurer.

The roster of new **Louisiana Section** officers reads as follows: Bernard A. Grehan, president; Hu B. Myers, first vice-president; Frank C. Fromherz, second vice-president; and Roy G. Cappel, secretary-treasurer.

A full agenda of **Maine Section** business was cleared up at the annual meet-

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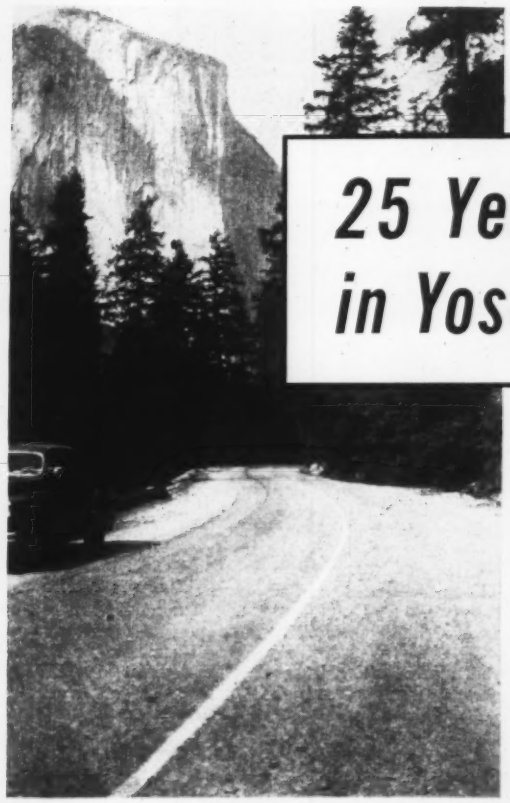

25 Years of Good Roads in Yosemite National Park

*By permission of Beech-Nut Life Savers, Inc., for candies

1933: Heavy-duty pavements of Bitumuls Penetration Macadam.

Just over 25 years ago, engineers of Yosemite National Park prepared for an expanded program of road surfacing. Located far from any hot-mix plants, they specified the then-new Bitumuls® Penetration Macadam type of construction.

This sound pavement provided excellent service, even in areas where snow, ice, and rigorous weather prevail for many months of the year. These roads in Yosemite are now open the year-around for winter sports enthusiasts.

With the improved road system, visitors came to the Park by hundreds of thousands. As a result of this heavier-than-anticipated traffic, combined with the severe weather, the need for an organized maintenance program became obvious. That's when the Park Engineers turned to Bitumuls Surface Treatment as a proved "life saving" maintenance tool.

1948: For 15 years, occasional Bitumuls Surface Treatments have kept pavements in top shape.

1957: Newly-introduced Bitumuls Slurry Seal also used for road and walk maintenance.

Bitumuls Surface Treatments not only successfully extended the life of the pavements, but also provided all-year, skid-proof, safe surfaces.

In 1957, Park officials employed another American Bitumuls development known as "Bitumuls Slurry Seal." This new technique is a very economical "life saver." It performs a "holding action" against weathering and further deterioration, permitting continued use of the pavement ahead of planned resurfacing.

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Call our nearest Bitumuls office for details on these paving and maintenance techniques, and for the "Bitumuls/Life Saver" story.

New ASCE Life Members in Metropolitan Section, pictured in presentation ceremony at the Engineers Club of New York on January 23, are: (left to right, front row) Rudolph F. Schaefer, Jacob Mechanic, David L. Snader, Clarence McDonough, Frank M. Evans, Frederick J. Biele, Van Tuyl Boughton, Roman von Fabrice, and Maurice T. Bolmer. In back row, left to right, are Roger Gilman, president, Metropolitan Section, who presented the certificates; James M. Webster, Alexander Lyle, John G. English, Irving Jacobs, Horace A. Sawyer, Alan G. Cherry, Frank J. Oleri, Ralph H. Mann and John Leahy. Only 18 of the 31 new Life Members were able to attend.

ing held in Pittsfield on January 25. New Section officers for the coming year are Horace A. Pratt, president; Lawrence K. Murphy, vice-president; Edward C. Jordan, secretary; and Frank M. Taylor, treasurer.

The **Mid-South Section's** Branches are off to a busy new year. The history and development of the telephone industry were reviewed at the January meeting of the **Jackson Branch.** Featured speaker was James E. Tubeville, customer relations manager of the Southern Bell Telephone and Telegraph Company, who stressed new developments and services that will affect Mississippi telephone users. Members of the **Memphis Branch** heard a delightful talk about a recent trip to Europe. The traveler and speaker of the evening was C. B. Weiss, sales manager of the Buckeye Cellulose Corporation, whose jaunt took him to England, Holland, Germany, Luxemburg, France, Italy, Switzerland, and Belgium. Officers of the **Vicksburg Branch** for the coming year are James W. Dement, Jr., president; Russell C. Baker, vice-president; and William J. Flathau, secretary-treasurer.

A recent **Nashville Section** meeting owed much of its appeal to George R. Dempster, the many-faceted speaker of the evening. Mr. Dempster described his experiences as a shovel operator on construction of the Panama Canal, his inventions and equipment company, his adventures in politics, and his television debut.

Members of the **National Capital Section** heard an authoritative talk on soil engineering at their January meeting. Featured speaker was Edward S. Barber, associate professor of civil engineering at the University of Maryland, who accompanied his talk with a rapid sequence of slides illustrating methods of soil exploration and testing.

Members of the **Oregon Section** heard a fine, five-sided discussion of electronic computers and their application to civil engineering problems, at their December meeting. Dave Lewis introduced the subject, explaining the theory and operation of the computer. Dave Rockwood, of the Corps of Engineers, discussed the applications of the machine to stream flow forecasts. Earthwork problems can also be solved by the computers, according to George LeTourneaux of the Oregon State Highway Department. They are especially valuable for this work because greater refinements can be secured, they are faster than any other instrument, and numerous trials can be made to find the desired result. Holly Cornell added that many firms prefer the computer to the analyzer because in a revaluation of a recently checked network system, the analyzer must be completely re-set, while the computer is simply fed the information punched on cards. Finally Harvey Miller, of the Corps of Engineers, explained how structural members can be designed by the computer-beams and columns are easily adaptable while odd-shaped members present more complications.

The balloting is over in the **Puerto Rico Section.** Returns name Francisco Lizardi, president; Antonio R. Torres, vice-president; Hector A. Deliz, vice-president; and Juan R. Figueroa, secretary-treasurer.

ASCE Membership as of February 10, 1958

Members	9,844
Associate Members	13,350
Junior Members	17,207
Affiliates	77
Honorary Members	44
Total	40,522
(Feb. 8, 1957	39,358)

It was Life Member night for the **Seattle Section** on January 17. Honored were Seattle civil engineers, John M. Adams and Samuel De Moss. Mr. Adams is an engineer with the Seattle branch of the Alaska District of the Corps of Engineers, and Mr. De Moss, assistant professor of general engineering at the University of Washington.

The **Spokane Section's** monthly publication, *The Bulletin,* will be under the guiding hand of Gilbert Grey. The former editor, Verne Chaney, is busy preparing for a series of examinations. Mr. Grey is no newcomer to work on *The Bulletin,* having aided Mr. Chaney.

At the January dinner meeting of the **St. Lawrence Branch** of the **Syracuse Section,** guest speaker was F. J. Dobson, project manager of the Sir Adam Beck Generating Station No. 2, being completed by the Ontario Hydro-Electric Power Commission at Niagara Falls, Ontario. Engineers from Canada engaged in construction of their portion of the Power and Seaway Projects in the area were invited to attend, and gave the meeting an international flavor.

As backdrop for Raymond Dawson's report on the New York Convention, the **Austin Branch** of the **Texas Section** held a dinner meeting. After Mr. Dawson's report, there was a program dealing with the engineering problems involved in Texas' new two-billion-dollar industry, off-shore drilling. The program—prepared by University of Texas professors Hudson Matlock and Lymon C. Reese—included a description of the off-shore piling

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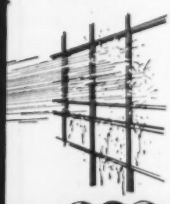

Spandrels—Here the designer has infinite choice. The V-panels are aluminum, bronze, stainless steel, Color Galbestos or vitreous enameled aluminum or steel. *Versatile-Wall is as individual as your signature!*

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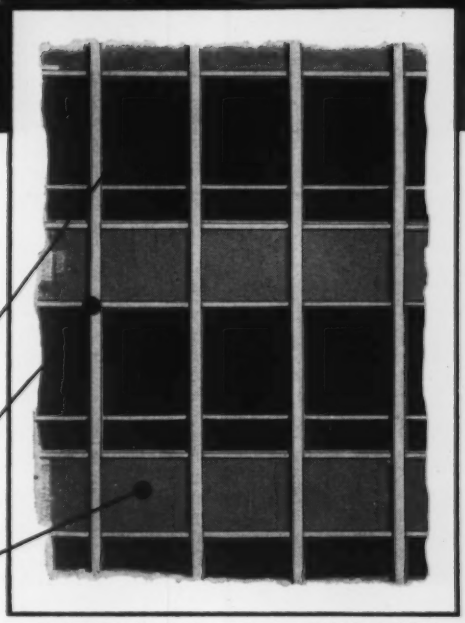

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ADDRESS 43 CITY

Southern Idaho Section's January meeting featured addresses by E. S. Kirkpatrick, Assistant to the Executive Secretary, and Louis E. Rydell, Director for District 12. Here John Griffiths, president of the Section, confers with Mr. Kirkpatrick, center, and Mr. Rydell.

Northwestern Branch of the Indiana Section held its annual meeting to elect new officers and hear W. H. Wisely, executive secretary of ASCE, speak on public relations for civil engineers. Gathered here for some shop talk are (left to right) J. I. Perry, Section president; Leo Louis, vice-president; William Shillinger, president of Northwestern Branch; Mr. Wisely; and Arthur Arndt, secretary-treasurer of Branch.

research being conducted at the university. Performance of heavy-duty pavements was discussed at a recent meeting of the **Brazos County Branch.** Featured speaker was Brig. Gen. John C. Elliott, now retired and with Spencer J. Buchanan & Associates, of Bryan.

In the midst of a heavy snow-storm, the **Tri-City Section** held a well-attended dinner meeting on January 21. After the business had been taken care of, I. M. Viest was introduced and presented a discussion of the AASHO test road and bridges being built near Ottawa, Ill. Mr. Viest highlighted his talk with slides showing various stages of construction.

At a recent meeting, the **Wisconsin Section** honored four of its members with Life Membership Certificates, Herb Bandtel, Marshall Findley, Louis Larson and Walter Peirce. The election and installation of the new officers of the Section followed. Office-holders are William G. Murphy, president; William W. Warzyn, first vice-president; Henry B. Wildschut, second vice-president; and Donald D. Roethig, secretary-treasurer.

ASCE CONVENTIONS

PORTLAND CONVENTION
Portland, Ore.
Multnomah Hotel
June 23-27, 1958

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 13-17, 1958

LOS ANGELES CONVENTION
Los Angeles, Calif.
Hotel Statler
February 9-13, 1959

DISTRICT COUNCIL MEETINGS

NEW ENGLAND COUNCIL MEETING
Union Building
University of New Hampshire
Durham, N. H.
March 29, 1958

DISTRICT 9 COUNCIL CONFERENCE
Akron, Ohio
Sheraton-Mayflower
April 18-19, 1958

Local Section Conference
April 17-18

DISTRICT 10 COUNCIL CONFERENCE
Atlanta, Ga.
April 11-12, 1958

Local Section Conference
April 9-10

PACIFIC SOUTHWEST COUNCIL CONFERENCE
Phoenix, Ariz.
Westward Ho
April 17-19, 1958

LOCAL SECTION MEETINGS

Joint Area Committee—Panel meeting in Room 103, School of Nursing, University of Toronto, April 3, 6:30 p.m.

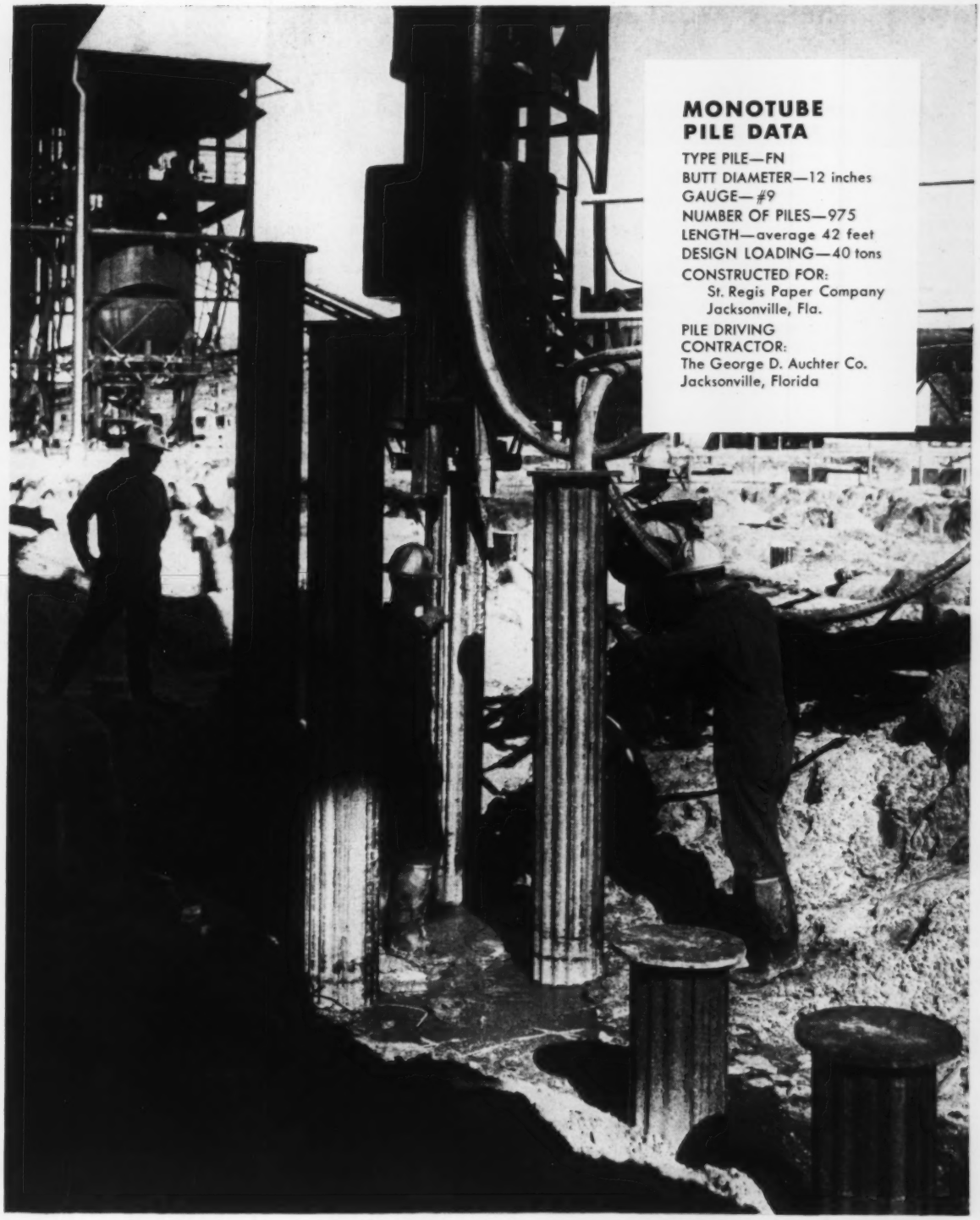
Los Angeles—General dinner meeting at the Rodger Young Auditorium, March 12, 6:30 p.m.; annual spring banquet of the Junior Member Forum at the Michaels Restaurant, April 3, 6:00 p.m.; dinner meeting of the Soil Mechanics Group at the Rodger Young Auditorium, March 19, 6:30 p.m.; dinner meeting of the Sanitary Group at the Engineers Club, March 26, 6:30 p.m.; reception and dinner meeting of the Transportation Group at the Engineers Club, Biltmore Hotel, March 27, 6:30 p.m.; dinner meeting of the Construction Group at the Thistle Inn, March 20, 6:00 p.m.

Metropolitan—Annual dinner meeting at the Brass Rail Restaurant, 100 Park Avenue, March 19, 6:00 p.m.; regular meeting, April 16, in the auditorium of the Engineering Societies Building, 7:00 p.m.

Mid-Missouri—Dinner meeting at the College Inn of the Hotel Edwin Long, March 25, 7:00 p.m.

Northwestern—Sixth Annual Soil Conference in conjunction with the University of Minnesota at the University of Minnesota, April 3.

Virginia—Meeting of Norfolk Branch, third Monday of every month, at 12 noon, in the YWCA Cafeteria; meeting of the Richmond Branch, first Monday of every month, at 12:15 p.m., at the Hot Shoppe Cafeteria; and meeting of the Roanoke Branch, second Wednesday of every month, 6:30 p.m., at the S & W Cafeteria.



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BY-LINE WASHINGTON . . . . .

Sputnik has shattered the economy mood of Congress. And the result probably will be, wherever construction is concerned, a running struggle with the Administration over how much should be spent for some public works programs.

The President submitted a budget last month calling for $6.7 billion to carry on his major construction programs during fiscal 1959—military and atomic energy construction, roadbuilding, water resources development, schools, hospitals and airports. This would be a healthy 18 percent over estimated expenditures this year.

However, the Administration made it clear it wants to continue its policy of "stretching-out" federal public works programs. "In view of the high level of commitments made in the last few years," the Bureau of the Budget explained, "the budget makes no provision for starting any new water resources projects in 1959 by the Corps of Engineers and the Bureau of Reclamation." In addition, new authorizations for other federal-aid programs, such as grants for hospital and school construction should be reduced.

Here's how the Administration's budget breaks down: Highways, $2,439 million; military construction, $2,104; water resources development $978; buildings, other facilities, $484; schools and hospitals, $225; atomic energy, $233; and airports, $202. The total is $6,665 million.

The President definitely recommended turning back to the states such public works projects as water pollution control, in the interest of putting all available federal revenues into the defense effort and balancing the budget.

* * *

Congress sees it differently. There are several reasons why observers here believe public works authorizations will not be curtailed. One is that the recession has Congress considerably bothered, particularly in this election year when they are most susceptible to pointed questioning from the unemployed. Many are casting a fresh and enthusiastic eye upon so-called "pork barrel" projects which might sustain local business and labor back home. So public works spending is being advocated energetically as a brake against further recession. And if projects can be billed as essential to the national defense, they are even more likely to win Congressional approval.

In short, the President's budget may be considered just a launching platform for somewhat more ambitious authorizations at the other end of the Avenue.

Shades of the PWA: The seriousness with which Congress views the recession and the adroitness with which it turns to public works spending as a backstop was aptly illustrated in a proposal offered by Senator Albert Gore late last month. The senator talked of breadlines in Tennessee and then urged that Uncle Sam put up $500 million for state and local public works projects. The first objective? To relieve unemployment in areas hardest hit by the down swing in business. Senator Gore would make the federal funds available for construction jobs upon application of governors or city officials, and on a 90-10 matching basis. The program would be separate from, and in addition to, the regular federal-aid programs for roads, airports, water pollution control, urban renewal, and other public works.

* * *

The Corps of Engineers has spelled out its construction plans for the future, too, under the Administration philosophy. Last month Maj. Gen. W. K. Wilson, deputy chief of engineers, for construction, outlined the prospects for both civil works projects and military construction.

Only enough new money will be fed into the civil works program to keep it going. There will be, if Administration orders prevail, no new starts on the 1958 budget until very late in the fiscal year. And the same outlook would prevail for fiscal 1959.

The military construction go-slow policy has been reversed and funds will be freed immediately for a huge backlog of lettings. The Corps plans to obligate about a billion dollars worth of work during the next four months. "It should be a very busy spring in our military construction offices," the general phrased it.

He also sketched some of the construction involved in the new missile development program. The Air Force or the missiles developer may design the technical facilities required, but the Corps expects to handle the construction on its established contract basis. There are "gray areas" the general said, which will make the first division of responsibility experimental here, but the projects now getting under way are only a beginning of what promises to be "a major program for the future."

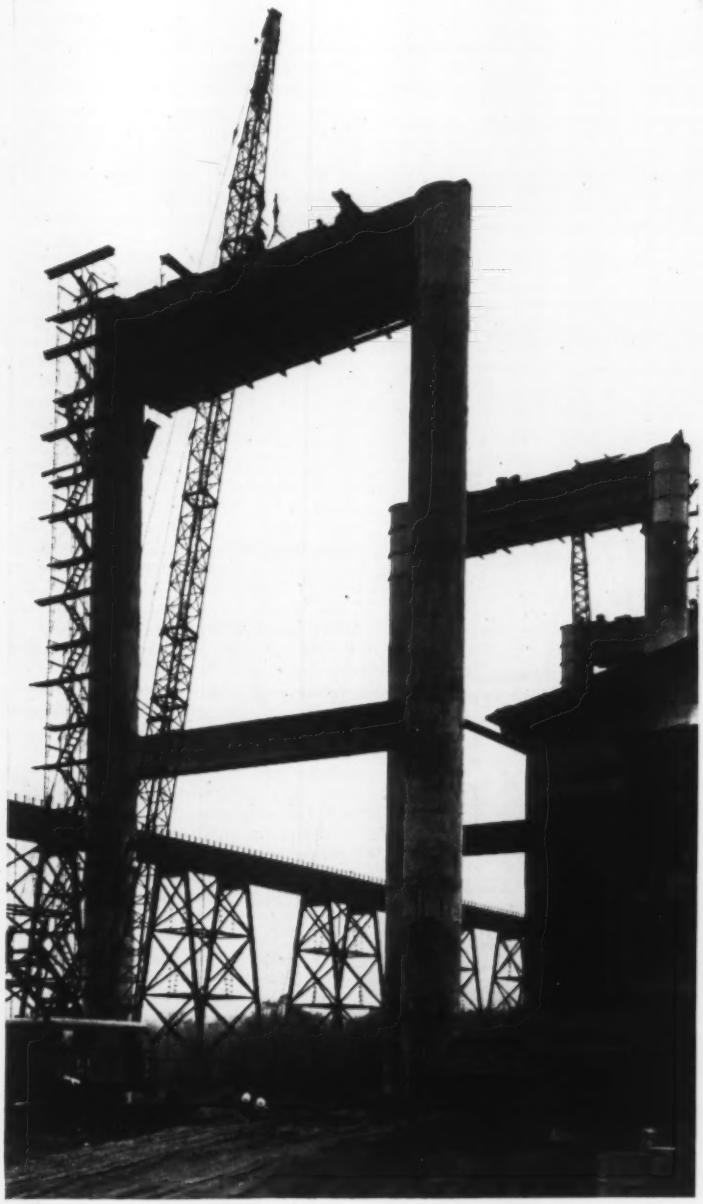
* * *

The President had his say last month about the multitude of proposals to extend federal aid for scholarships to boost the nation's supply of technical manpower. In his economic report, he opined that the Russian threat could not be met by greater federal appropriations or by federal interference in the educational system of a free society. Instead, he called for broad remedial action by "citizens, community organizations, schools, foundations, business firms, labor groups, professional societies, the press, and state and local governments."

* * *

A national shelter construction program is back in the limelight again this month. A Congressional subcommittee has revived plans for a multi-billion-dollar endeavor in the light of Russia's lead in missile weapons. Hearings will begin soon on proposals, one of which is the $34-billion plan submitted some time ago by the Federal Civil Defense Administration. FCDA recommended dual purpose shelters to protect against blast, heat and fallout in target areas and against fallout alone in thinly populated sections. The shelters could serve as underground parking garages, school rooms and hospitals.

Blaw-Knox Steel Forms cut costs on 135-foot high bridge piers, were used without falsework



22-ton steel cap form hoisted into place by crane with 160-ft. boom. Blaw-Knox Steel Forms were re-used an average of 27 times on the project. Note the absence of falsework and cross girders.

When Johnson-Kiewit, joint-venturers on the new mile-long Hudson River Bridge south of Albany, were faced with the construction of 42 concrete piers they chose Blaw-Knox Steel Forms for a fast, economical job. To form the pier columns, they used 320 lineal feet of 8-ft. diameter column forms fabricated in 5-ft. lengths by 180-degree segments.

As pouring progressed, the forms were supported on the work by special anchor bolts cast into the concrete. After a 20-ft. lift was complete, the form assembly bolts were loosened along the vertical joints and the form was hoisted to rest on the previously set anchor bolts. This operation was repeated as the columns were built up.

Strut forms for intermediate and cap beams weighing 22 tons were lifted into place by crane and supported entirely on the work. This required a variation of the standard column form which was equipped with a collar on which the beam form rests. These forms were anchored to concrete with 1½ in. bolts and special Blaw-Knox-developed shear blocks to transmit the heavy loads to the concrete columns. This arrangement framed into the end of the strut form so that the column and strut were poured monolithically.

Throughout the project, designed by Madigan-Hyland, the need for expensive cross girders to support the heavy strut and cap forms was eliminated. The Blaw-Knox Steel Forms, easy to set and strip, made possible as many as 27 re-uses.

No matter what your concrete project, bridges, dams, tunnels, sewers or prestress units, it will be to your profit to contact the Blaw-Knox Steel Form Consultation Service. There is no obligation. Contact us early in your planning for a profit-building engineering contribution.

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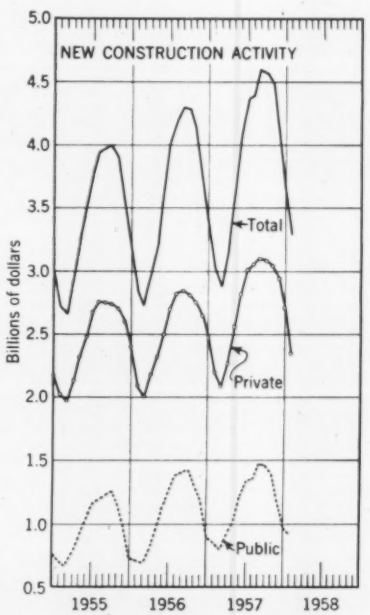
NEWS BRIEFS . . .

January Construction Sets Record for Month

Expenditures of $3.3 billion for new construction put in place in January set a new record for that month, exceeding by 3 percent the previous January high set in January 1957, according to preliminary joint estimates of the U. S. Departments of Commerce and Labor: Outlays in January declined from December by 10 percent—no more than usual for the time of year—and were at a seasonally adjusted annual rate of $48.5 billion, compared with actual outlays of $47.3 billion in the peak year 1957.

Private spending for new construction, totaling nearly $2.4 billion this January, was up slightly from last January. Private construction's main strength stemmed from the record January spending for public utilities, office buildings, churches, and hospitals. In addition, outlays for new private dwellings were only 3 percent less than in January 1957—the smallest over-the-year decrease since January 1956, when the dollar value of new housing began declining. However, industrial construction and store building dropped 11 and 16 percent, respectively, from January 1957 levels. On a seasonally adjusted basis, industrial plant construction retreated to the March 1956 volume, while store building hit the lowest point in 36 months.

Public construction outlays showed a 6 percent gain over the January 1957 level and, for the first time, exceeded a seasonally adjusted annual rate of $15 billion. The rise was stimulated by new January highs in outlays for highways, public schools, and sewer projects. Expenditures for public housing were more than double the amount spent in January 1957 and were the highest since February 1952. However, activity in some public segments declined materially this January, with water facilities and military projects dropping 14 percent.



January construction expenditures, at $3.3 billion, are 3 percent above the previous January high established in 1957.

ARBA Says Bring on the Work

Julien R. Steelman, reelected president of the American Road Builders Association at its recent annual meeting in Washington, D. C., placed that organization squarely against any stretch-out of the current road program. His statement—and the consensus of the meeting generally—is that contractors, as well as materials and equipment suppliers, are ready, willing, and able to complete the huge road job in the planned thirteen years. Furthermore with plant and equipment ready to meet the planned schedule, some will be badly hurt by less work during the next years. All were against the federal government's suggested diversion of moneys from the Highway Trust Fund. And they were even more enthusiastically for additional money to keep the mileage total on schedule, despite an estimated 37 percent increase in cost.

More than 1,500 road builders attended the fifty-sixth annual convention in the Capital City. All were enthusiastically in favor of more roads as soon as possible. Corridor talk was of lower prices and plenty of ability to take on more work now. Spokesmen from both houses of Congress and the Executive Branch of the Government all argued for more money for completing roads sooner. Austin Kiplinger, of the Kiplinger Washington Letter, told the group that "government economy" is a forgotten phrase in Washington and the spending fever is rising.

Concerning primary highways, rural and urban roads, the so-called ABC program, George H. Fallon, chairman of the House Subcommittee on Roads, reported plans to increase this program $25 million a year in the hope of eventually making the present $900 million annual program total a billion annually. Mr. Fallon protested the administration's new budget that proposes to take a $68 million bite out of the Interstate System—$32 million collected from the tax on aviation fuel would be diverted to the General Fund; $32 million for forest and public land highways would come from the Highway Trust Fund rather than from the General Fund as heretofore. The Treasury would like to have $3.75 million for administering the Trust Fund, and the Department of Labor wants $250,000 for supervision of the Davis-Bacon provision of the Highway Act.

Senator Albert Gore of Tennessee, member of the powerful U.S. Senate Committee on Public Works, sharply criticized progress to date on highways and the statistics used in reporting work done. But he pledged resistance to grabs from the Highway Trust Fund and every effort to get additional money, if necessary, to complete the Federal Highway Program on the original schedule. Income from authorized sources may be substantially larger than now estimated, especially as we get better highways on which to travel. Senator Gore questioned lack of uniformity of standards among the states, with many refinements in some. This set the stage for Vice-President Nixon's comment that the administration would not accept "wider frills and shorter roads."

Money requirements of state highway departments have been increased rather than decreased by the federal spending for roads, according to Claude R. McMillan, highway commissioner of South Carolina and new president of the American Association of State Highway Officials. It is easy to lose sight of the 10 percent required from the states for the 90-10 federal-state apportionment for the Interstate Roads, above funds previously required for the primary system. To this must be added the cost of maintenance of the Interstate System.

G. M. Williams, M. ASCE, Assistant Commissioner for Engineering of the Bureau of Public Roads, brought the statistics up to date: In fiscal 1956, some 7,100 federal aid highway contracts were let, totaling $1.7 billion; in 1957 about

7,900 contracts totaling $2.5 billion. For 1958 it is expected that contracts will be advertised on 1,420 miles of high-type surface on the Interstate program that, with grading and bridges, will require expenditures of $1.2 billion, while $1.5 billion will go on primary, secondary, and urban programs. All the money available for apportionment from the Highway Trust Fund has been obligated.

ARBA set up a committee of consulting engineers to study means of better service to the road program and the question of consulting fees for highway design and construction. Guy Kelcey, of Newark, N. J., is chairman. The other members are Morris Quade, of New York City; J. Stephens Watkins, of Lexington, Ky.; Earle V. Miller, of Phoenix, Ariz.; and Charles De Leuw, of Chicago, Ill. All are members of ASCE.

In addition to reelecting Mr. Steelman president, the ARBA elected the following vice-presidents: J. E. McCracken, of the Bethlehem Steel Company; Nello L. Teer, Jr., of Durham, N. C.; Harold L. Plummer, of the Wisconsin Highway Commission; and W. A. Bugge, director of highways of Washington. O. J. Porter, of Newark, N. J., was named head of the Engineering Division of ARBA.

New York Bank in Business as Usual During Rebuilding

To keep a busy bank open for business while the structure housing it is being rebuilt and enlarged sounds almost impossible. However, this problem is being solved by the Bankers Trust Company, which will construct a nineteen-story modern office building above and around its largest branch office, located on the southeast corner of Fifth Avenue at 44th Street. Unwilling to close down its branch during demolition of the old building and construction of a much higher new one, Bankers Trust is profiting by modern engineering techniques that make it possible to do business as usual.

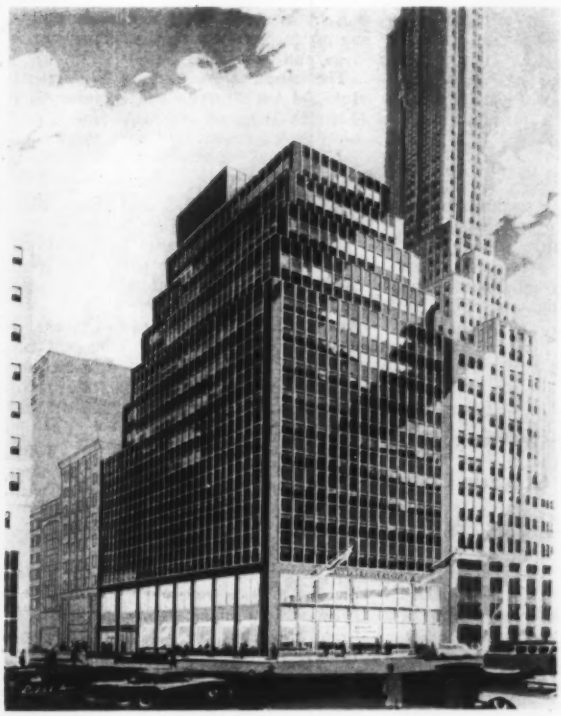
To achieve maximum utilization of the site, eight stories will be added to the existing eleven-story steel-framed building. An adjoining six-story structure will be demolished and the enlarged site incorporated in the completed nineteen-story building project.

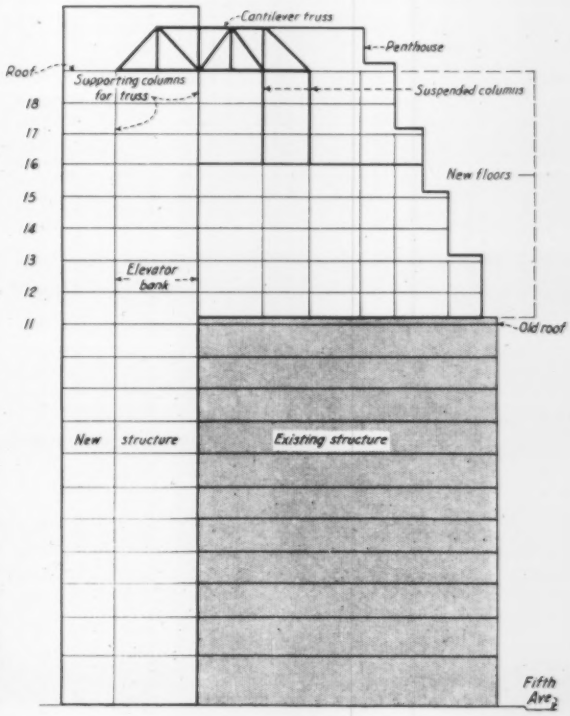
The existing steel columns are inadequate to carry the additional eight floors. However, reinforcing these columns with welded cover-plates down to the third floor will make it possible to carry the additional load, with the exception of two interior columns for the top three floors. The structural engineer decided to use a special truss to pick up these two columns. The columns, with their tributary three-floor loads, will be supported by cantilevering the truss from the nineteenth floor out over the existing building. As suspended hangers, the columns carry over 120 tons apiece. The 12-ft-high truss itself will be enclosed in the penthouse, which will also house the elevator machinery and cooling tower.

The need for keeping weight down dictated the choice of a lightweight floor assembly using a steel cellular deck. This floor will be fireproofed by a modern technique—lightweight aggregate, acoustical plaster applied to a hung ceiling.

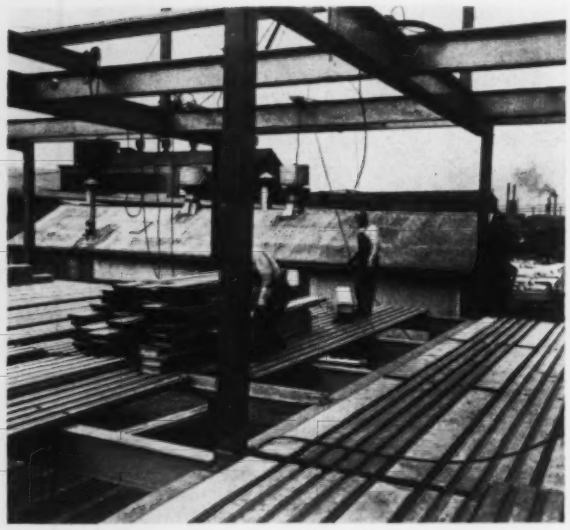
James Ruderman, M. ASCE, is consulting structural engineer on the Bankers Trust project, and Emery Roth is the architect. Material for this write-up was supplied by Mr. Ruderman and John G. Hotchkiss, A.M. ASCE, district engineer for the American Institute of Steel Construction.

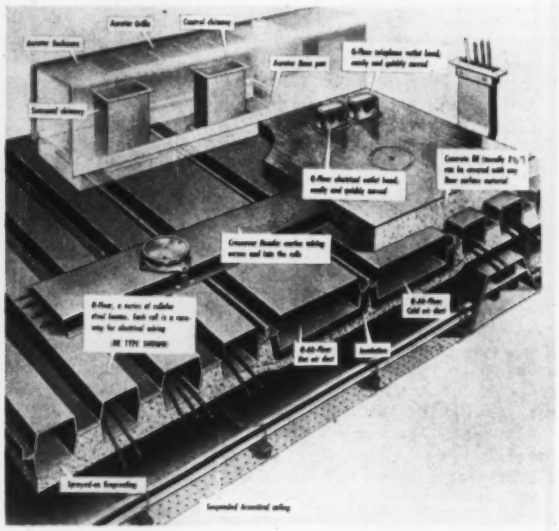
Nineteen-story office building, shown in drawing, will expand facilities of Bankers Trust Company's branch office at Fifth Avenue and 44th Street. The bank will keep its offices open as usual during construction. Shaded area of diagram (right) indicates the steel work and floor slabs that will remain after stripping old building above the third floor. The three top floors will be suspended from a cantilever truss.





Cells in Steel Floor Become Ducts for Air Conditioning





Cellular steel floor is being installed in office building of H. H. Robertson Company's Ambridge Plant (view at left). Of unique interest are the wide cells which carry conditioning air (right-hand sketch). Narrow cells serve as conduits for all electrical cables. Thermostats control mixing of hot and cold air at the baseboard outlets.

A Pittsburgh firm, the fifty-year-old H. H. Robertson Company, opened the doors of its new two-story and basement office building at its Ambridge Plant for the inspection of the technical press a few weeks ago. The unique feature of the building is the use of its cellular steel floor for a dual-duct air-conditioning and heating system.

For twenty-five years, the company has manufactured a cellular steel floor said to have been used in more than 14,000 installations. In addition to forming the load-bearing elements of the floor system, the standard-sized cells—3 by 3 in.—usually have been put to a secondary use as conduits to carry electric power, signal, and telephone cables.

Six years of research and development by the company, whose president, A. W. Coffman, is a doctor of philosophy in chemistry, made it clear that, for air-conditioning, cells larger than the standard 3 by 3 in. size were needed to reduce air friction losses in the system to a practical figure. In the cut-away illustration of a cellular floor installation it is to be noted that the air ducts had been enlarged to 3 in. by 9 in. Baseboard outlets include thermostatically controlled valves which mix the incoming hot and cold air to the room temperature desired.

By incorporating all the secondary duct work in the floor slab the ceiling-to-floor height is reduced by 8 to 16 in.—enough to save one floor in height in the usual twenty-story building.

In addition to the fully-monitored air-conditioning system, the building incorporates many other Robertson building products—walls, roof, windows, partitions, and ventilators.

The design is the work of William A. Rose, M.ASCE, structural engineer, and Oscar F. Wiggins, architect, New York.

Earthquake Effects on Nuclear Power Reactors

A joint study of the effects of earthquakes on nuclear power reactors will be undertaken by the Lockheed Missile Systems Division, Palo Alto, and Holmes & Narver, Los Angeles engineering and construction firm, according to an announcement by the Atomic Energy Commission. Holmes & Narver will have prime responsibility for structural and seismic analyses, while Lockheed will study design problems of the nuclear reactors themselves. George W. Housner, A.M. ASCE, professor of civil engineering and applied mechanics at California Institute of Technology and president of the Earthquake Engineering Research Institute, is acting as consultant on seismology to Holmes & Narver.

The year-long study is expected to evaluate earthquake hazards to major types of stationary reactors and to develop design criteria for minimizing or eliminating such hazards. The results of the study will be published in an AEC handbook for the guidance of industrial firms designing and building large reactors.

Hydroelectric Construction At High Level in Canada

Hydroelectric construction in Canada continued its upward spiral in 1957 as a result of increasing power demands. The total of 1,501,560 hp of new capacity was second only to the record high of new installations achieved in 1954 when 1,758,450 hp was installed. Other installations currently under construction are expected to add about 2,200,000 hp of new capacity in 1958 and more than 4,300,000 hp in the succeeding few years.

The greatest increases to individual plant capacity in the past year were at the Bersimis I plant of the Quebec Hydro-Electric Commission and the Kemano-Kitimat (British Columbia) plant of the Aluminum Company of Canada. Each of these installations brought into operation 300,000 hp of new capacity. The total installed capacity of water-power plants in Canada is now listed at 19,871,008 hp, which represents less than 28 percent of total potential. However, several sites with large potential capacities are being investigated, and it is likely that they will be developed in a few years.

Free copies of a report on the water power picture—entitled *Hydroelectric Progress in Canada, 1957*—are available from the Director, Water Resources Branch, Department of Northern Affairs and National Resources, Ottawa, Canada.

Largest Man-Made Storage Caverns Mined

Rock miners are at work at Linden, N. J., drilling the country's largest man-made storage caverns for the Esso Standard Oil Company's Bayway Refinery there. When completed this year, the network of underground rock-wall caverns will be able to store more than 28,000,000 gal of liquified petroleum gas. Mined at a minimum depth of 300 ft below the surface, the storage caverns are a honeycomb of interconnected tunnels drilled, blasted, and scooped out of solid shale. Eventually this network will include 6,000 lin ft of tunnels—most of them 13 ft wide and 22 ft high.

Work on the Bayway Refinery underground storage caverns began in October 1956, when a drilling rig was put in operation to bore the main shaft. All equipment and workmen are sent underground through this 42-in. steel-lined shaft, and rock and dirt come out the same way. The electrical bucket lift operates at a rate of 2,200 fpm. Equipment was dismantled above ground and lowered into the excavation, piece by piece. This included a heavy bulldozer, two rocker shovels, and four front-end loaders. There are five drilling shafts, each 42 in. in dia. and fourteen 12-in. ventilation shafts.

Fenis and Scisson, Inc., rock-mining specialists of Tulsa, Okla., are the general contractor on the project. The drilling is handled by the Layne New York Co.

Foreign Technical Information Center

New measures to increase scientific knowledge have been taken through the establishment of a Foreign Technical Information Center within the Department of Commerce. To finance the project, the Department is requesting a special appropriation of $300,000. In addition, the President's 1959 budget calls for $1,250,000 for the Department's Foreign Technical Information Program.

The new program will set up a central clearing house in the Commerce Department's Office of Technical Services. The Center is to collect, evaluate, and distribute valuable foreign scientific and technical literature for the use of American scientists and engineers. According to Commerce Secretary Sinclair Weeks, the center will fill a long-felt need for an agency for making foreign engineering and scientific information generally available to American scientists, research institutions, and the public.

Arrangements have been made with the National Science Foundation, the Atomic Energy Commission, the Armed Services, and other agencies to supply abstracts and translations of foreign technical articles, monographs, and books. It is expected that these will be made available at an annual rate of 50,000 abstracts and 10,000 complete translations. The items will be catalogued in the Office of Technical Services, which releases between 600 and 700 new and nonclassified reports of government research each month. Important data in the OTS library include many German research papers captured by the Allies.

Steel Companies to Spend Billion Dollars in 1958

The nation's iron and steel companies plan to spend about $1 billion for additions to and replacement of their facilities, according to the American Iron and Steel Institute. This tremendous outlay will be substantially less than last year's record expenditures of $1.75 billion for expansion and improvement. The 1957 expenditures brought the total capital investment by the industry, since World War II, to over $9.9 billion.

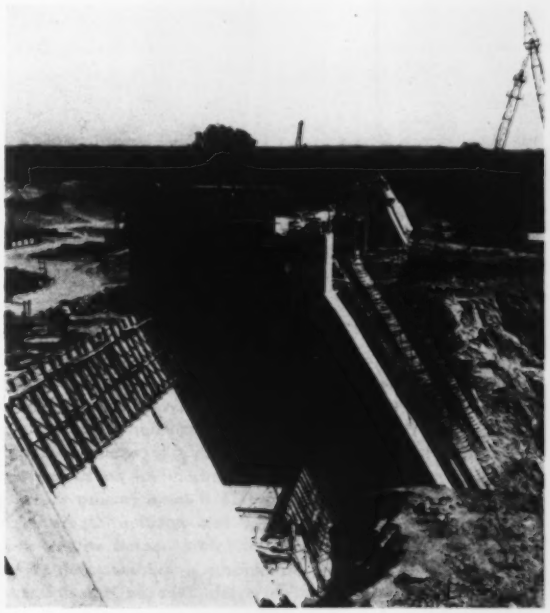
As a result of this expansion plants are more diversified and better equipped than ever before. In the past decade the annual steelmaking capacity of the country has been increased by 46.5 million tons. The industry's present capacity—a record 140.7 million tons a year, as of January 1—is considered adequate to meet the demands of any foreseeable national emergency.

Venezuela Enters Era of Heavy Industry

By April of 1958 the government of Venezuela will complete the first phase of vast industrialization plans for an area once completely uninhabited except for Puerto Ordaz—the five-year-old ore-loading town built by U.S. Steel in connection with its fabulous Cerro Bolivar ore development.

Key project in the government's plan is a $36,000,000 dam on the Caroni River, ten miles south of Puerto Ordaz, which will start this spring to furnish power for a new steel mill also under construction. The mill, which will cost ten times as much as the dam, will have a capacity of 650,000 tons of steel in its first-stage production, to be completed in 1958. Its eventual capacity will be 1,200,000 tons. A workers' town that will house 85,000 persons is also being built. The dam is designed for an ultimate output of 300,000 kw of electrical power through Francis turbines driving six 50,000-kw generators. Its initial capacity, available in April, will be 50,000 kw, and 200,000 kw is the output planned for 1959.

In charge of the project is Rafael Alfonzo-Ravard, A.M. ASCE, a graduate of M.I.T. He calls the Caroni "one of Venezuela's greatest natural resources." The 130-mile stretch of river south of its juncture with the Orinoco has a hydroelectric potential of over 8,000,000 kw—more than half of it economically usable. The river has its source in a wild and uninhabited area, scene of Conan Doyle's *The Lost World*. When finished in 1960, the new open-hearth-furnace Orinoco Steel Plant will be the biggest in Latin America (occupying a site of 667 acres) and one of the most modern in the world. Some 100 engineers, 300 experts and 5,000 workers will have a hand in its construction.



Caroni Dam, set for completion this spring, will provide power for Venezuela's first steel mill now under construction. Its ultimate output will be 300,000 kw.

AGC Forecasts Good Year at Annual Convention

Construction volume in 1958 will be good, the 2,400 persons attending the recent 39th annual convention of the Associated General Contractors were told. The contractors, meeting in Dallas, Tex., February 10-13, heard that there will be a huge program of military construction but curtailed civil works. There was talk, too, of a possible program of shelter construction on a very large scale. Despite the generally optimistic outlook, the group was warned that 1,000 general contractors and even more subcontractors will fail this year.

During the convention, Fred W. Heldenfels, Jr., contractor and civil engineer of Corpus Christi, Tex., was installed as AGC president for a one-year term, succeeding Lester C. Rogers, M.ASCE, of Chicago. James W. Cawdrey, of Seattle, Wash., became vice-president.

Maj. Gen. A. M. Minton, director of installations for the U.S. Air Force, told the contractors that Air Force construction awards in 1958 will be at least double—and perhaps considerably more than double—awards for any year since World War II. A great number of them will be for structures in the United States of a type never before conceived, to meet blast pressures of high magnitude. Improved protection for defense installations against 200-psf blast loads is a major requirement. Among other seriously needed facilities is better housing for 50,000 Air Force personnel in this country.

The Corps of Engineers construction situation will improve, Maj. Gen. W. K. Wilson, Jr., deputy chief for construction, reported. Sufficient funds will be available to keep contracted civil works at least moving. Much of the military construction that has been held back will be crowded into spring activities. On civil projects little new work can be started, and only a small number of awards can be made on existing work—and these will be limited to work necessary to keep major projects moving. The Air Force—best construction customer of the Corps of Engineers—has authorized a full program. Four BOMARC missile installations have been authorized and more are planned for the next fiscal year. All possible work in continental U.S. will be let on a public competitive bidding basis. Foreign work necessary will be negotiated.

More money is needed at once to continue work on Glen Canyon Dam and the Trinity River development, W. A. Dexheimer, Commissioner of the Bureau of Reclamation, reported to AGC. Work has been going along well on both projects, but may have to slow down if Congress does not supply additional funds for this fiscal year. Some 200 construction contracts with a face value of $355 million, are under way, with 99 percent of it to be done by contract. Mr. Dexheimer said that his office is trying to work out an acceptable means of providing relief to contractors.

C. R. McMillan, highway commissioner of South Carolina and president of the American Association of State Highway Officials, blamed disillusionment concerning the highway program on an exaggerated idea of the amount of additional work to be done. Because of the increase in federal aid and talk in terms of the total program, many assumed the work would be several times greater than the usual volume. Actually the work to be done by the contractors is only 40 to 60 percent greater, as much of the money goes into right-of-way, engineering costs, and the like. This may be the reason why some equipment manufacturers have overexpanded. Mr. McMillan reported that authorization is being asked in Congress to advance payments on costly materials delivered to the job before they are incorporated into the work. This would relieve some of the financing problems of contractors.

James D. Marshall, executive director of AGC, reported that even with the steadily expanding construction market, business failures among contractors have increased. The problems of being successful in business are multiplying with the complexities of labor-management bargaining, legislation, industry relations, taxation, and depreciation.

During the twelve years that the volume of construction has increased, failures among firms in the industry have increased faster, according to Hal C. Dyer, Dallas contractor.

Many who have not failed have a lower net worth than they had in 1951. It is expected that 1,000 general contractors will fail this year, leaving a $75 million tab for someone to pick up. Mr. Dyer quoted Dun & Bradstreet to the effect that 587 construction subcontractors failed during the first six months of 1957 with a loss of $20 million. Performance bonds should help to control the overexpansion that is frequently responsible for failures, but some bonding companies are as reckless as the contractors.

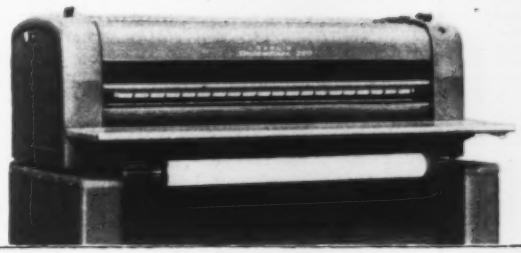
Inflatable Rubber Bag Expedites Homebuilding

Newest tool in the construction field is this giant inflatable rubber bag, which is being used to raise the roofs and lower the floors of demountable homes being built for construction workers at the Glen Canyon Dam and Power Plant site. Developed by B. F. Goodrich Aviation for use in erection of houses made by Transea Homes Corporation, the air bag takes the place of a crane or sixteen men previously needed to unfold the homes from their accordion-like pack. The air bag inflates to a cell measuring 11 ft in diameter and 15 ft long, raising the roof as it inflates. As the bag deflates, the floor is lowered into position. Operating speed is controlled by compressor. The bag is made of fabric coated with a special man-made rubber resistant to high and low temperatures, mildew, and abrasion. Weighing only 80 lb, it is easily moved from job to job. Transea Homes is at Fullerton, Calif.

Engineering Education Movie

For some time the AGC's Education Committee has been assembling the necessary footage for a film entitled "The Constructors," which is directed toward the junior high school age group. The final production was shown at the 39th annual convention. A questionnaire has been circulated to all AGC chapters to guide the committee in determining the number of prints of the film that will be required. Sixty-nine chapters have reported that they are in areas serving more than 16,500 high and junior high schools.

How to make design changes in minutes . . . and cut drafting costs, too



There's no more need to bog down drafting operations with time-wasting tracing or redrawing of your original design.

Now with Ozalid intermediate materials, you can make design changes quickly, neatly, easily. Ozalid intermediates give you exact duplicate originals that can save you *hours* of drafting time. Specific detail changes are as simple as 1–2–3. Just make an Ozalid intermediate print . . . on film, translucent paper, or cloth . . . and remove obsolete details with Ozalid Corrector Fluid. If you prefer, unwanted details can be removed by "scissor-editing" or the "lock-out" method. Next, draw in your new design and you've got a new, up-to-date original . . . all ready for running prints.

And with the convenience of the *table model* Ozalid Streamliner 200, you can run prints off in seconds . . . *full 42" width* prints that are yours at *low cost*. No more waiting for prints. Now *anyone* in your office can turn out sparkling whiteprints on-the-spot.

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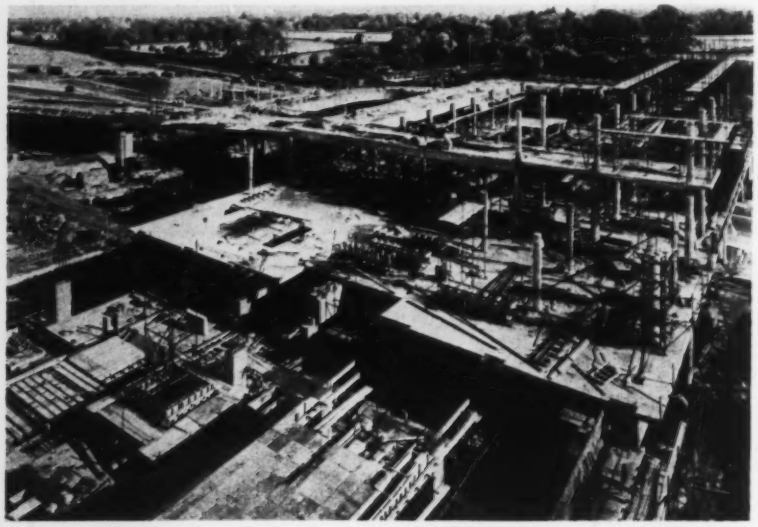
AWWA Nominates Officers for 1958

Lewis S. Finch, M. ASCE, vice-president and chief engineer of the Indianapolis (Ind.) Water Company, has been nominated president of the American Water Works Association for 1958. Lauren W. Grayson, M. ASCE, general manager and chief engineer of the Glendale (Calif.) Public Service Department, will be vice-president, and William J. Orchard, director of Wallace & Tiernan Inc., Belleville, N. J., treasurer. The nominees were chosen at the annual meeting of the AWWA board of directors, held in New York City early in January. They will be considered elected if no other nominations are filed by March 1. Installation will take place at the annual convention of the AWWA, to be held in Dallas, Tex., April 20-25.

Two of the association's four newly-elected honorary members are also members of ASCE. They are Victor M. Ehlers, director of the Division of Sanitary Engineering, Texas State Department of Health, and Fred G. Gordon, assistant chief engineer, Bureau of Engineering, Chicago Department of Public Works. Mr. Ehlers is cited in part as "one who has devoted his life to the health and welfare of the people of his great state." Mr. Gordon is honored as "An engineer thoroughly grounded in the criteria of his profession; one who possesses the ability to evaluate those elements essential to the development of reliable facilities for water supply installations."

Ray L. Derby, M. ASCE, has been awarded the 1957 Diven Medal "for his noteworthy work in the field of control of water quality." Harvey O. Banks, M. ASCE, is winner of the Resources Division Award for his paper on "Salt Water Intrusion in California," published in the January 1957 issue of the AWAA Journal. By unanimous decision of the committee, the Harry E. Jordan Scholarship has been awarded to James D. Goff, a senior in civil engineering at Southern Methodist University.

London Terminal Serves Air, Road and Rail Traffic



London's new Gatwick Airport, under construction at a cost of $19,600,000, will be completed this summer in time to handle tourist traffic. It will be the first terminal in the world to combine air, highway, and rail transport facilities in a single unit. Both fast electric trains and a through highway connect the terminal with the heart of the city. An innovation in British civil aviation practice is the finger-type system of connecting aircraft with the terminal building. The project is being built in two stages. The first, to be completed in the late spring, includes construction of the basic airport facilities on a 660-acre site, with one main runway 7,000 feet long. It also involves diversion of the main London-South Coast arterial highway. The second stage, which will be started as soon as use of the airport warrants expansion, provides for another major runway of 6,000 feet. The runways are being built to handle the heaviest jet airliners, in case they have to be diverted by bad weather from London Airport. Normally they will handle the short- and medium-range aircraft.

New Jersey to Have Guided Missile Base

Construction of the first Bomarc guided missile launching site in the country got under way at McGuire Air Force Base in New Jersey on January 20, when the Philadelphia District of the Corps of Engineers conducted ground-breaking ceremonies. The work is proceeding under a $5,996,000 joint-venture contract held by the Roscoe Engineering Corporation and the Ajax Construction Company for the building of fifty-six launcher structures. The structures will be equipped with movable roofs to provide shelter. The contract also includes clearing and excavation of the site and construction of two compressor buildings and miscellaneous installations.

Raymond Concrete Award Honors Memory of Founder

Establishment of the Alfred A. Raymond Award "to encourage originality in research and development in the field of foundation engineering" is announced by the Raymond Concrete Pile Company. The annual award honors the memory of Alfred A. Raymond, founder of the company (in 1897) and inventor of the first cast-in-place concrete pile. It carries an honorarium of $1,000.

Those taking part in the competition will be asked to prepare papers "on any of the phases of the design and construction of foundations for structures." Manuscripts will be accepted from practicing and professional engineers, faculty members of accredited engineering schools, and graduate students. The deadline is September 1.

Engineers interested in submitting papers should register and apply for detailed instructions by writing to the Alfred A. Raymond Award, Room 1214, 140 Cedar Street, New York 6, N. Y.

New Arc Welding Competition Open

A new prize paper contest is announced by the James F. Lincoln Arc Welding Foundation, which is offering forty-six cash awards in its annual mechanical and structural design competition. The top award is $1,250. Awards will be made in two separate classes—one for mechanical designs and one for structural designs.

Open to undergraduates only, the competition offers awards for papers describing the design of a machine, machine part, structure or structural component, which makes significant use of arc welding. Designs made for regular school work will be acceptable. Closing date is July 1, 1958. Rules are available from the James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

NEW "DESIGN PRACTICES" Manual

AVAILABLE AT NO CHARGE!

...provides an excellent addition to your pavement design file

The Expansion Joint Institute, composed of the major manufacturers of premoulded joint materials who have united to provide research, product development and technical data for the construction industry, has released a new manual, "Design Practices And Uses Of Premoulded Joints In Concrete Pavements." This manual, is the first of its type ever produced and was prepared in answer to many requests for a technical manual concerning the uses of expansion joints.

You'll find the comprehensive technical data and illustrations on the many types of premoulded joints, their applications and installation information included in this manual a very valuable addition to your design file. Send the coupon below for your copy, today!

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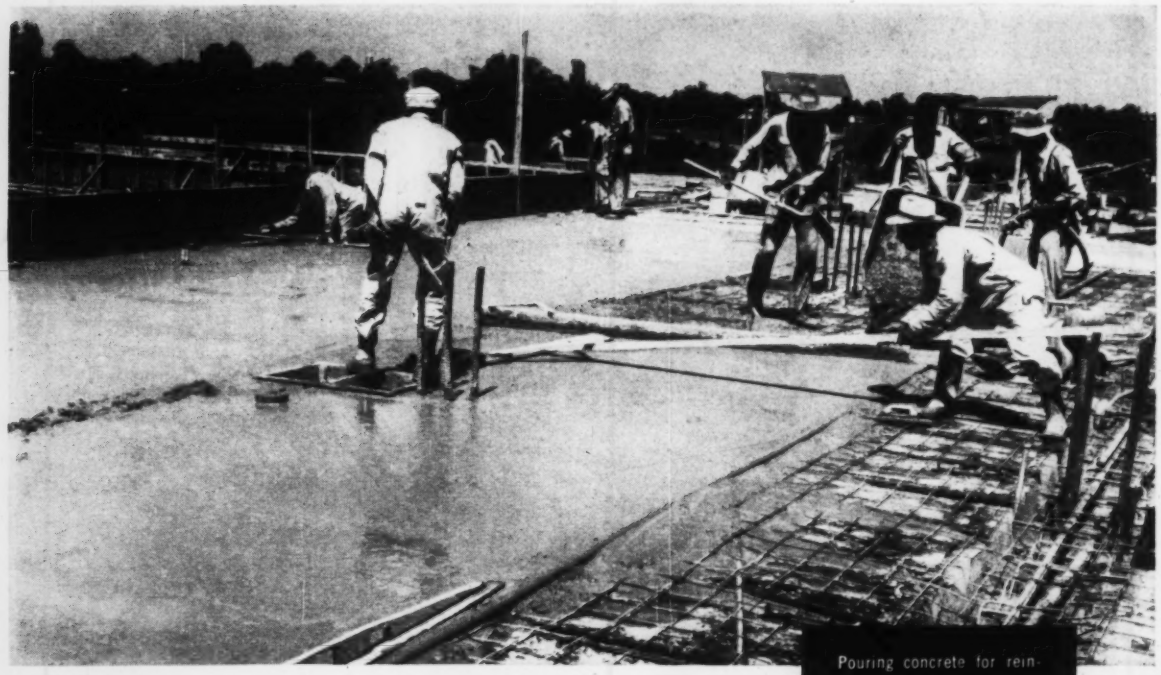

Pouring concrete for reinforced second floor slab for Houston Hospital and Dyer's Clinic, Houston, Mississippi.

ARCHITECT
Ellerbe & Company
St. Paul, Minn.

ASSOC. ARCHITECT
William I. Rosamond
Columbus, Miss.

CONTRACTOR
G & K Construction Co., Inc.
Pascagoula, Miss.

DEALER
Dendy Lumber Company
Houston, Miss.

Lehigh Mortar Cement contributed to good-looking exterior masonry in this new three-story, 65-bed Mississippi hospital.

Mississippi Contractor meets tight schedule with . . .

LEHIGH EARLY STRENGTH CEMENT

To meet the completion date requirement of their contract, the G & K Construction Company, Inc., set up a tight working schedule for this job at Houston, Mississippi.

By using Lehigh Early Strength Cement in the columns, floors and roof, they were able to keep within the time limit, yet avoid doubling form costs.

As a result, they saved $5500 on form and general overhead costs, and 35 to 40 days construction time.

That's why we say "Somewhere on nearly every job, Lehigh Early Strength Cement will save you time and money."

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- LEHIGH EARLY STRENGTH CEMENT
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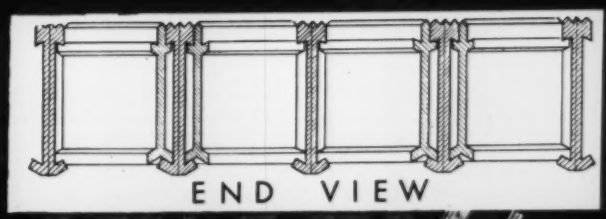
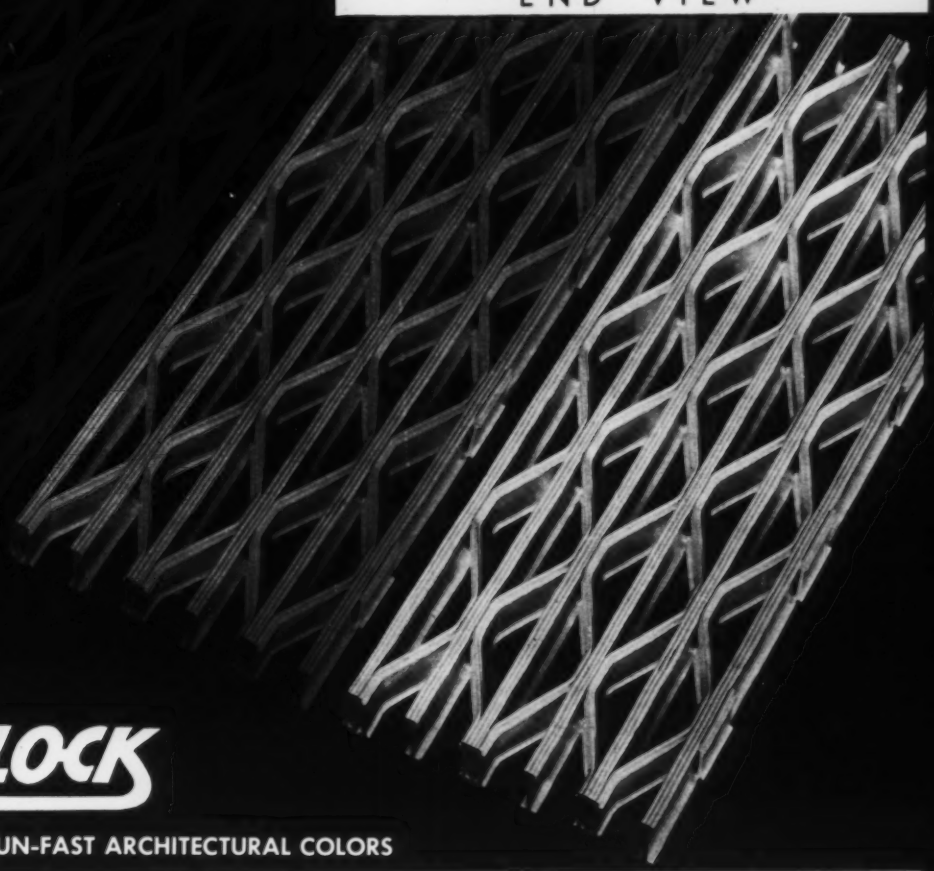




Roll-Lock

AVAILABLE IN A RANGE OF SUN-FAST ARCHITECTURAL COLORS

Kerrigan's New Concept in Multi-Purpose Aluminum Grating Brings You NEW ECONOMY in Non-sparking, Non-rust, Corrosion-resistant Grating

ECONOMICAL ALUMINUM GRATING with crimped bars permanently ROLL-LOCKED into bearing bars to form a solid one-piece, rattle-proof unit is Kerrigan's latest contribution to open metal flooring design.

Non-rust, corrosion-resistant features make it highly desirable for installations where chemical conditions prevail —sewage plants in particular—and the non-sparking quality eliminates fire hazard. Where slippery conditions indicate extra precautions, Serrated ROLL-LOCK is available to provide additional safety. At the same time, the grating panels are reversible and can be used smooth-side-up to form "slide-paths" for movement of boxes, bags, and packages.

ROLL-LOCK is also handsome and decorative for wall panels, column facings, sunshades, spandrels, and grills. To blend with the new look in buildings it is available in beautiful anodized sun-fast architectural colors and architectural bronze.

←TEAR OUT AND FILE. VALUABLE CATALOG INFORMATION ON OTHER SIDE. WRITE FOR DESK SAMPLE C.

Weldforged GRATING DIVISION

KERRIGAN IRON WORKS, Inc.

Nashville, Tennessee

GENERAL SALES OFFICE - 274 MADISON AVENUE, NEW YORK, N. Y.

KERRIGAN SAFE LOAD TABLE FOR ROLL-LOCK ALUMINUM GRATING

Size of B. Bars	Type	Approx. Wgt. Lbs. per Sq. Ft.		DEFLECTION EQUAL TO 1/160 OF SPAN IS NOTED IN PARENTHESIS.																					
				(.150) 2'-0"		(.188) 2'-6"		(.225) 3'-0"		(.263) 3'-6"		(.30) 4'-0"		(.338) 4'-6"		(.375) 5' 0"		(.413) 5'-6"		(.45) 6'-0"		(.488) 6'-6"		(.525) 7'-0"		(.60) 8'-0"		(.675) 9'-0"	
1"	Roll Lock 1"	2.725	U	633		405		236	281	149	207	99	158	70	125	51	101	38	83		70		60		51		39		
			D	119		187		225	268	263	366	.30	477	338	604	375	746	413	903		1.074		1.261		1.461		1.909		
			C	633		507			422	326	362	249	317	197	281	159	253	131	230	110	211	94	195	81	181	62	158	49	141
			D	.095		149			.215	263	.292	.30	.382	338	.479	375	.597	413	.722	.45	.859	488	1.008	525	1.169	.60	1.527	675	1.933
1¼"	Roll Lock 1¼"	3.204	U	931		596		414		274	304	183	233	129	184	94	149	70	123	54	103	43	88		76		58		46
			D	095		149		214		263	292	30	381	338	482	375	595	413	720	45	857	488	1.006		1.166		1.523		1.928
			C	931		745		621			532	458	465	362	414	293	372	242	338	203	310	173	286	149	266	114	234	90	207
			D	076		119		.171			.233	.30	.305	338	.386	375	.476	413	.576	.45	.686	488	.805	525	.933	.60	1.219	675	1.543
1½"	Roll Lock 1½"	3.693	U	1276		817		567		417		301	319	212	252	154	204	116	168	89	142	70	121	56	104	37	79		63
			D	079		123		177		242		.30	.315	338	.399	375	.493	413	.596	.45	.709	488	.833	525	.965		1.261		1.596
			C	1276		1021		851		729		638		567		482	510	399	464	334	425	285	392	240	364	188	319	148	283
			D	063		099		143		195		254		322		375	.397	413	.480	.45	.572	488	.671	525	.778	60	1.016	675	1.286
1¾"	Roll Lock 1¾"	4.91	U	1957		1253		870		639		489		384	386	279	313	210	258	161	217	127	185	102	160	68	122	48	96
			D	067		105		151		206		269		338	.340	375	.420	413	.508	.45	.605	488	.710	525	.823	60	1.075	675	1.360
			C	1957		1566		1305		1118		979		870		783		712		607	652	517	602	446	559	341	489	269	435
			D	054		084		121		.165		215		272		336		406		.45	.484	488	.568	525	.658	60	.860	675	1.088
2"	Roll Lock 2"	6.28	U	2984		1910		1326		974		746		589		477		359	394	276	331	217	282	174	243	116	186	82	147
			D	060		094		135		184		240		304		375		413	.454	45	.54	488	.634	525	.735	60	.96	675	1.215
			C	2984		2387		1989		1705		1492		1326		1194		1085		995		884	918	761	852	583	746	460	663
			D	048		075		108		147		192		243		30		363		432		488	.507	525	.588	60	.768	675	.972

Aluminum type 6063T6 used for bearing bars—type 6063T5 for crimped bars

Using Aluminum type 6061T6 for bearing bars, add approximately 20% to above table . . . (slightly higher in price)

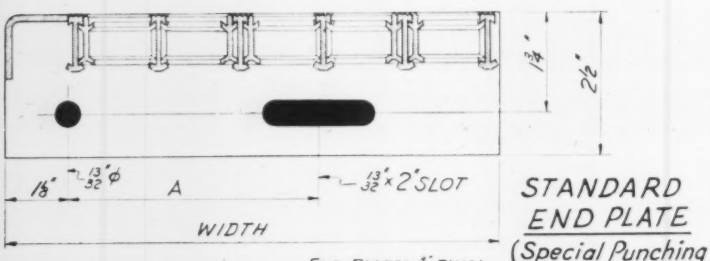
KEY FOR LOAD TABLE

U—Uniform load capacity in pounds per square foot. C—Concentrated load capacity in pounds per foot of width. D—Deflection in inches. All loads based on 10000 psi allowable stress. All deflections based on 10000000 psi Modulus of Elasticity. All loads are theoretical, wgt. of grating not deducted. Loads shown with yellow background will cause deflection in excess of 1/160 of span.

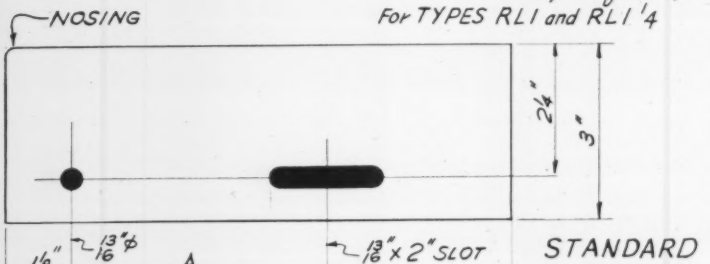
FRACTIONAL WIDTH PANELS FURNISHED TO FILL OUT OVERALL AREAS

25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
35⅞	34⅜	32⅞	31 7/16	30	28½	27	25 9/16	24	22 9/16	21⅛	19⅝	18 1/16	16 1/16	15¼	13¾	12¼	10 13/16	9 5/16	7⅞	6⅜	4 1/16	3 7/16	2

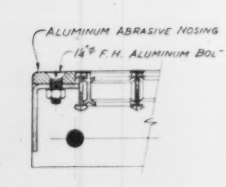
STAIR TREADS



STANDARD END PLATE (Special Punching by Request.) For TYPES RL1 and RL1¼



STANDARD END PLATE (Special Punching by Request.) FOR TYPES RL1½ and RL1¾



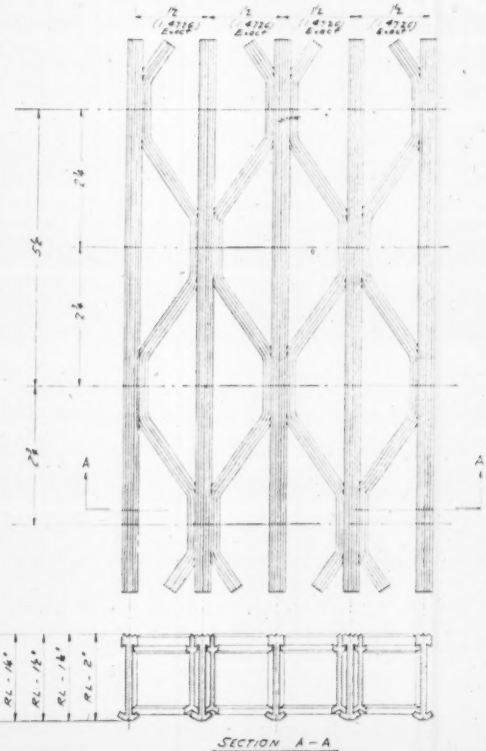
DETAIL OF ABRASIVE NOSING

TABLE OF TREAD WIDTHS

WIDTH	DIM. A
5 5/8	2½
7⅜	4½
8⅜	4½
10⅜	7
11 1/8	7
13⅜	7

ALUMINUM GRATING

ROLL-LOCK TYPE



SECTION A—A

Weldforged GRATING DIVISION OF . . .

KERRIGAN IRON WORKS, Inc.

Nashville, Tennessee

GENERAL SALES OFFICE - 274 MADISON, N.Y.C.

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Moles Present Heavy Construction Awards

Presentation of top honors in the heavy construction field took place at The Moles annual awards dinner held at the Waldorf-Astoria in New York City on January 29. This year's ceremonies honored Francis Donaldson, of Bronxville, N. Y., and Peter F. Connolly, of Osterville, Mass., the eighteenth pair of recipients.

The non-member award presentation to Mr. Donaldson was made by Thomas J. Walsh, board chairman of the Walsh Construction Company and an award winner himself in 1955. Mr. Donaldson, who has been with the Mason & Hanger Company since 1926, was praised especially for his "skill and imagination" in designing the foundation for the New Jersey towers of the George Washington Bridge. The presentation of the member award to Mr. Connolly was made by Edward G. Johnson, of the Arthur A. Johnson Corporation. As president of a company bearing his name, Mr. Connolly has been responsible for many important tunnel and foundation jobs in and around New York. It was said of him that he "sees the bottom of every caisson of every job his company undertakes."

Principal speaker at the awards dinner was Federal Highway Administrator Bertram D. Tallamy, M. ASCE. Richard A. Johnson, president of The Moles, was in the chair. There was an attendance of over 1,100 at the dinner.

Housing Construction Reported Down in 1957

Last year construction was started on 1,039,200 nonfarm houses and apartments, according to preliminary estimates of the U. S. Labor Department's Bureau of Labor Statistics. The 1957 figure, the lowest since 1949, was down 7 percent from 1956. However, the rate of decline was less than half that shown between 1955 and 1956. December starts dropped slightly more than usual for the time of year, to 62,000—slightly below the December 1956 total.

There were 989,700 private dwelling units started last year—the first time since 1949 that this figure was below the million mark. The 10 percent decline in the 1957 private total, which was entirely in metropolitan areas, reflected a smaller volume of single-family houses than in 1956. However, there was a sharp rise (about 40 percent) in private apartment building to the largest volume since 1952. Housing begun with FHA mortgage assistance accounted for about the same proportion of the private total as in 1956. Publicly owned housing, started in 1957, totaled 49,500 units—more than double the 1956 figure and the largest public-housing total in five years.

Region-wise, last year's decline in housing starts was sharpest in the northern states. The rate of decrease in the West was only about half that in the North. Actually in some metropolitan areas of the West, housing activity showed marked gains over 1956. The South, with some highly active home-building areas such as Miami, showed an upturn in private housing starts. It accounted for about a third of the 1957 total, with the Western and North Central regions accounting for a fourth.

N. G. Neare's COLUMN

R. Robinson Rowe, M. ASCE

"What a pal Cal turned out to be!" muttered Joe Kerr.

"Louder, if you want me to hear," demanded Professor Neare.

"I want everybody to hear. I've got the problem all worked out except that I forgot to copy down the price of fencing, but Cal wont tell me so he can be the smart guy again."

"Show me what you did and then we'll have a showdown."

"Well, the problem is drawn on this map (Fig. 1). Instead of running right-of-way fence thru P to Q, it was shortcut to B and triangle PBQ was bought for a cent per sq ft, with a saving of

$$S = f(u - v) - A \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where f is the cost per ft of fence, u and v are sides PQ and PB and A the area of the triangle. In terms of u and the deflection ϕ, I found

$$v = u/(\sin \phi + \cos \phi \quad \ldots\ldots\ldots\ldots (2)$$

$$A = \tfrac{1}{2} uv \sin \phi \quad \ldots\ldots\ldots\ldots\ldots (3)$$

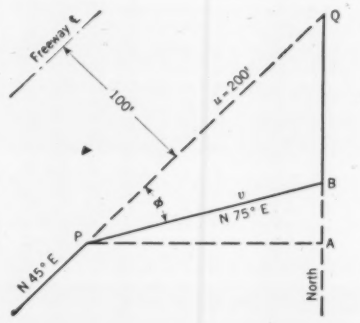


Fig. 1. Buying PBQ and fencing PB instead of PQ saved $73.20.

$$S = fu - \frac{fu + \tfrac{1}{2} u^2 \sin \phi}{\sin \phi + \cos \phi} \quad \ldots\ldots\ldots\ldots (4)$$

"The problem was to find ϕ for a maximum saving, so I set $dS/d\phi = 0$ and derived the relation

$$u = 2f(\cos \phi - \sin \phi \quad \ldots\ldots\ldots\ldots (5)$$

which gives the answer, because $u = 200$ and f is the known price of fencing which Cal held out on me!"

"Then let's proceed to the showdown," smiled the Professor. "Cal, have you been teasing Junior Members?"

"Only those that ask for it," retorted Cal. "Joe asked for the price of fencing and I offered to tell him tomorrow. He went berserk before I could explain that the price wasn't given and wasn't needed, and that I could compute it but hadn't. I'm sorry now, for his equations are all correct and he might have finished when he realized that the minimal triangle was a function of both ϕ and u. Then from (4), setting $dS/du = 0$, he would derive

$$u = f(1 + \cot \phi - \operatorname{csc} \phi \quad \ldots\ldots\ldots\ldots (6)$$

which could be solved simultaneously with (5) to obtain

$$2 \cos \phi - 2 \sin \phi + \operatorname{csc} \phi - \cot \phi = 1 \quad (7)$$

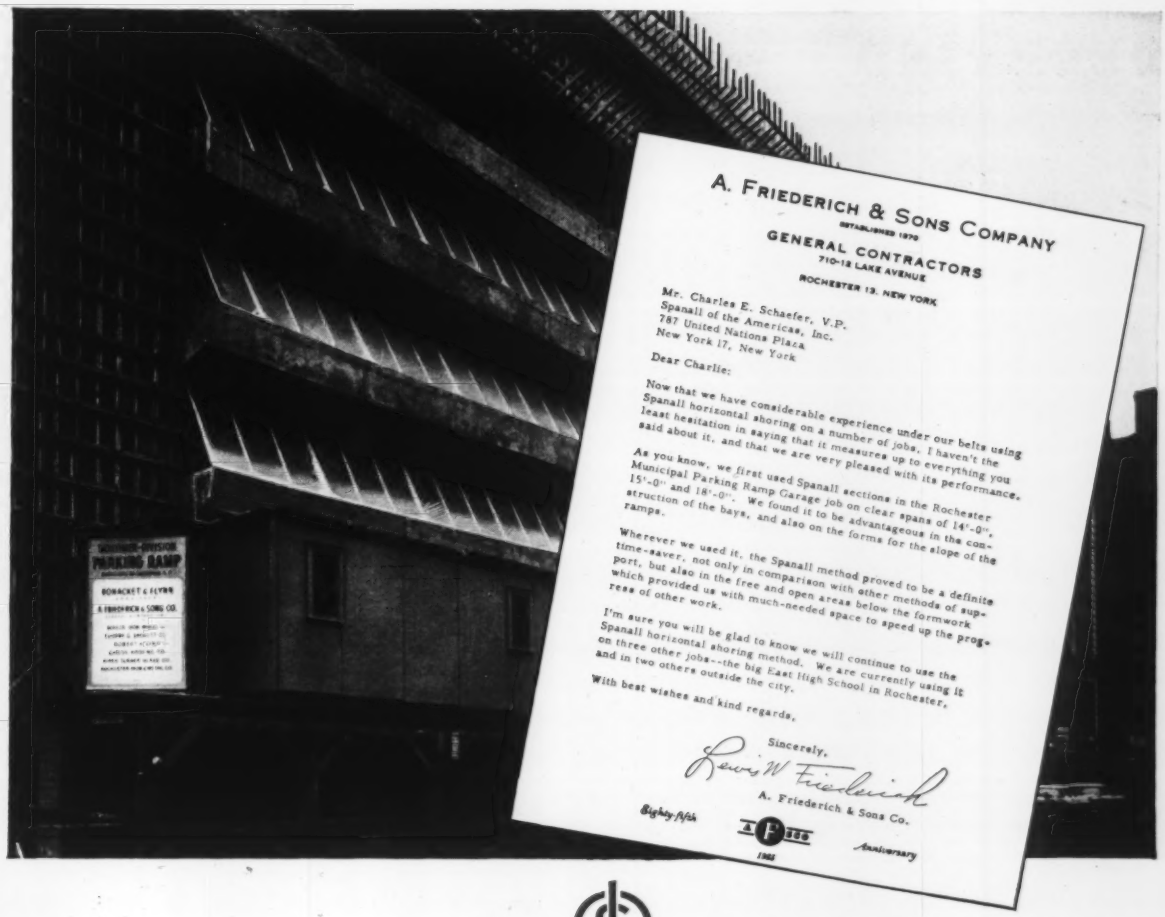
$$\phi = 30° \ldots (8)$$

and fence PB bears N 75° E."

"Exactly, but you went to a lot of extra work. No matter what the angle APQ, it will be trisected by PB. The relative cost of land and fence fixes the point P, but is not a factor in the bearing of PB. I see Joe grinning at Cal's chagrin, so, to keep you out of each other's hair, I'm going to assign you separate parts of a sequel problem. Each of you will now need the price of fencing, which from (5) or (6) is $100(1 + \sqrt{3})$.

"Your problem, Joe, is to locate the best cut-off fence running due east from some point on PQ to section line AQ. You, Cal, can find the best curved fence line. This will give us 3 "bests," connecting which there is a surprising geometric relation; I don't ask you to find it, but it will help you if you do."

[Cal Klaters were Sauer Doe (Marvin Larson), David V. Messman, S. K. Rueball (Keith Jones), and Laurence V. Degnan. Also acknowledged are solutions of December's wax-falf problem from Walter Tudor, Messman, Richard Jenney, German Gurfinkel and Paul H. Sanders.]



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ESTABLISHED 1870
GENERAL CONTRACTORS
710-12 LAKE AVENUE
ROCHESTER 13, NEW YORK

Mr. Charles E. Schaefer, V.P.
Spanall of the Americas, Inc.
787 United Nations Plaza
New York 17, New York

Dear Charlie:

Now that we have considerable experience under our belts using Spanall horizontal shoring on a number of jobs, I haven't the least hesitation in saying that it measures up to everything you said about it, and that we are very pleased with its performance.

As you know, we first used Spanall sections in the Rochester Municipal Parking Ramp Garage job on clear spans of 14'-0", 15'-0" and 18'-0". We found it to be advantageous in the construction of the bays, and also on the forms for the slope of the ramps.

Wherever we used it, the Spanall method proved to be a definite time-saver, not only in comparison with other methods of support, but also in the free and open areas below the formwork which provided us with much-needed space to speed up the progress of other work.

I'm sure you will be glad to know we will continue to use the Spanall horizontal shoring method. We are currently using it on three other jobs—the big East High School in Rochester, and in two others outside the city.

With best wishes and kind regards,

Sincerely,
Lewis W. Friederich
A. Friederich & Sons Co.

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1883

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HORIZONTAL SHORING

Today there is no product, no method more efficient, nor more time-saving, than SPANALL—the modern, all-steel, *horizontal* shoring for all types of beam and slab concrete deck and floor forms.

This fact was well demonstrated in the construction of the Rochester (N. Y.) Municipal Parking Ramp Garage, as attested in the above letter from the general contractor. Plans called for a grid dome job, with clear spans of 14'0", 15'0" and 18'0"—the latter spans applying to the bays clearly indicated in the photo. SPANALL, spaced 2 feet o.c., were supported by 4 x 6 ledgers on 4 x 4 shores. Except for these 4 x 4 shores, the areas below the SPANALL formwork remained free and clear for much needed traffic and uninterrupted work progress. Cost savings with SPANALL on this type of work average up to 40%.

That's why, on job after job, from coast to coast, in Canada and in Latin America, SPANALL is now accepted as *the one* time-saving, cost-saving horizontal shoring method for concrete floor and deck forms.

Call your local SPANALL distributor today for catalog and complete details. Or write directly to Dept. C.

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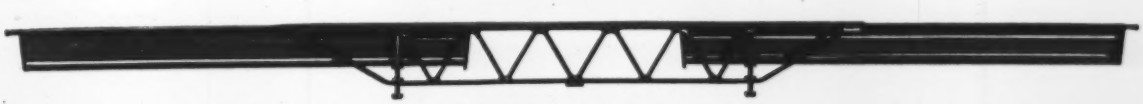
787 United Nations Plaza, New York 17, N. Y.



SPANALL — WITH BUILT-IN CAMBER — IS ENGINEERED FOR AMPLE LOAD-BEARING SAFETY FACTOR

DECEASED

David Bonner (M. '31), age 69, vice-president of the Frederick Snare Corporation, New York, died on January 15 at his home in Great Neck, N. Y. A graduate of Princeton University, Mr. Bonner was a specialist in heavy construction. During his career, Mr. Bonner had been associated with Roger & Hagerty, Henry Steers Inc., the Raymond Concrete Pile Company, and the Metropolitan Sand and Gravel Company. He had served as president of the Metropolitan Section, the Princeton Engineering Association, and The Moles.

Raymond W. Brooks (A.M. '19), age 69, assistant office engineer for Black & Veatch, consulting engineers of Kansas City, Mo., died there on January 7. Mr. Brooks, who graduated from the University of Illinois, was with the Missouri Highway Department for many years. His positions included project engineer on several highway projects and chief designer for the Bureau of Surveys and Plans.

John M. Buckley (A.M. '24), age 64, consulting engineer for the New York City Department of Marine and Aviation, died at his home in Teaneck, N. J., on January 18. Mr. Buckley, who had been with the Department since 1949, played a key part in the planning of New York City's $200,000,000 waterfront reconstruction program. For more than 25 years, Mr. Buckley served as a civilian engineer with the Corps of Engineers, specializing in rivers, harbor work, and dock construction. Mr. Buckley was a graduate of Rensselaer Polytechnic Institute with a degree in civil engineering.

Casper Buechner (A.M. '24), age 65, consulting construction engineer for the New York City Board of Education, died recently at his home in Woodhaven, N. Y. Mr. Buechner was a graduate of Rutgers University and a veteran of World War I, in which he served in the Corps of Engineers. In addition to his work with the Board of Education, Mr. Buechner earlier held the post of consultant for the State of New York. He had been with the Board for ten years.

William A. Burton (A.M. '16), age 73, chief engineer of the Paris & Mt. Pleasant Rail Road, died in Mt. Pleasant, Tex., on December 26. During his long career with the railroad, Mr. Burton filled various posts. Before joining the road he was a hydrographer in irrigation and drainage work.

Robert L. Burwell (M. '15), age 79, consulting engineer for the city of Annapolis, Md., died there on January 19. Mr. Burwell, who was a graduate of Cornell University, spent the major part of his career working in Maryland, his native state. He served as assistant engineer with the Baltimore City Water Department, roads engineer for Anne Arundel County, chief engineer for the Annapolis Metropolitan Sewerage Commission, and city engineer for Annapolis.

Lyman F. Copeland (M. '30), age 75, retired bridge engineer, died recently at his home in Denver, Colo. Mr. Copeland earned his B.S. degree at Worcester Polytechnic Institute, and his Civil Engineering and M.S. degrees from the University of Colorado. Long connected with the U. S. Bureau of Public Roads, Mr. Copeland was senior highway bridge engineer in administrative charge of the Bridge Division at the time of his retirement. He was a past-president of the Colorado Section of ASCE, and a member of Tau Beta Pi.

Fred W. Crocker (M. '35), age 72, chief engineer for Kaiser Engineers Overseas Corporation, died in Calcutta, India, on December 29. Mr. Crocker, who was born in Portland, Ore., was graduated from the University of California. He had served as chief engineer for the Columbia Construction Company and for the Permanente Corporation, both in California. For the past two years, Mr. Crocker had been in India as chief engineer for the Kaiser firm.

Farley Gannett (M. '17), age 77, chairman of the board of Gannett Fleming Corddry & Carpenter, Inc., died in Washington, D. C., on January 20. After graduation from Massachusetts Institute of Technology, Mr. Gannett held the post of chief engineer of the Water Supply Commission of Pennsylvania. Later he founded the Harrisburg consulting firm of Gannett Fleming Corddry & Carpenter, which he served as president for many years. His firm designed parts of the pioneer Pennsylvania Turnpike and worked on other superhighways. Mr. Gannett played a large part in designing and supervising the construction of a new water supply system for Harrisburg. He was an early president of the Engineers Society of Pennsylvania.

Joseph H. Gandolfo (M. '22), age 80, retired industrial engineer, died recently in Montclair, N. J. Mr. Gandolfo specialized in structural engineering, particularly power and industrial plants. He was graduated from the College of the City of New York with a science degree. Mr. Gandolfo had served as resident engineer with Moody Engineering Company in both San Juan, Puerto Rico and New York City. He had also been with the J. G. White Engineering Corp. and Westinghouse, Church, Kerr & Co., New York City. For many years, he worked with the Department of Institutions and Agencies for the State of New Jersey. He was also design and construction representative on the State Board of Control and Commissioners.

Sir Alexander Gibb (M. '21), age 86, leading consulting engineer in London for many years, died at Hartley Wintney, England, on January 21. Sir Alexander was directly responsible for construction of the King Edward VII Bridge over the Thames, the Ipswich Dock extensions, and H. M. Naval Base in Rosyth. After World War I, he was in charge of the reconstruction of the Belgian ports of Ostende and Zeebrugge. Among many other services performed for the Crown, Sir Alexander served as Director-General of Civil Engineering to the Ministry of Transport and as chairman of the Light Railroad Investigation Committee.

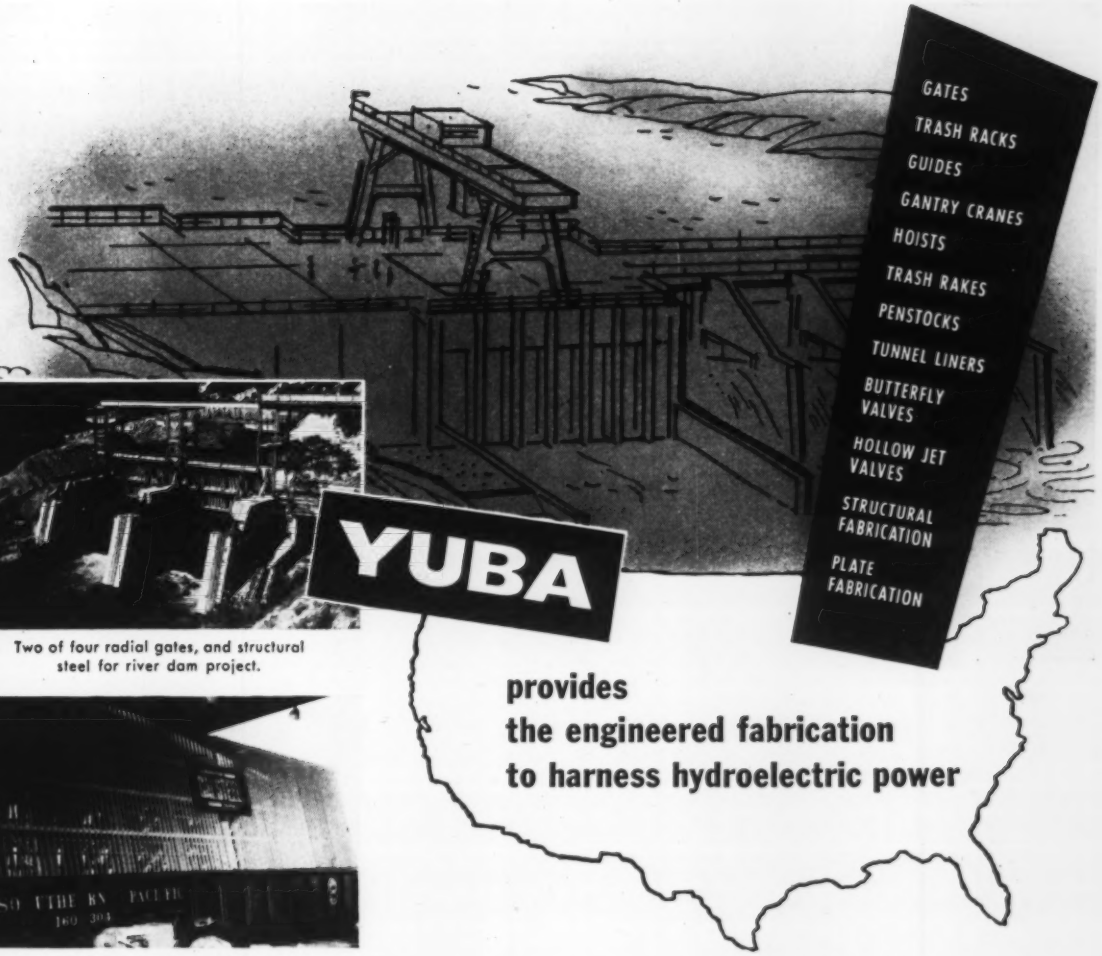
Paul M. LaBach (M. '13), age 85, retired consulting engineer, died in Los Angeles. For 25 years, Mr. LaBach was water service engineer for the Chicago Rock Island and Pacific Railway. During his long connection with the CRI & P, he reduced materially the cost of water service for the line. He was author of many articles on railroad maintenance, and had served on the ASCE Committee on Stresses in Railroad Tracks. He was also inventor of several water softeners. During World War I, he served with the AEF in France as water supply engineer for transportation. Mr. LaBach was a civil engineering graduate of the University of Cincinnati, and had a law degree from the University of Tennessee.

Richard L. Senior (A.M. '12), age 64, construction manager for the F. H. McGraw Company in New York, died at his home in New Rochelle, N. Y., on January 21. Before going to the McGraw Co. two years ago, he was operations manager for Peter Kiewit Sons Company on construction of the billion-dollar Portsmouth plant of the AEC. Earlier, as head of his own engineering and construction firm, he supervised construction of many large projects in the New York and New England area. Mr. Senior was a graduate of Brooklyn Polytechnic Institute and a veteran of World War I. In the recent war, he served as general superintendent for an American combine on the construction of naval facilities in Ireland.

Charles W. Sherman (M. '03), age 87, a retired partner of Metcalf & Eddy Engineers, died in Cambridge, Mass. on January 17. Mr. Sherman held degrees from both Massachusetts Institute of Technology and Cornell University. Mr. Sherman was with Metcalf & Eddy from its founding in 1907 until 1938, when he retired as partner. He continued as consulting engineer for the firm for several years. A long-time resident of Belmont, Mass., Mr. Sherman was chairman of its Board of Water Commissioners from 1925 to 1932.

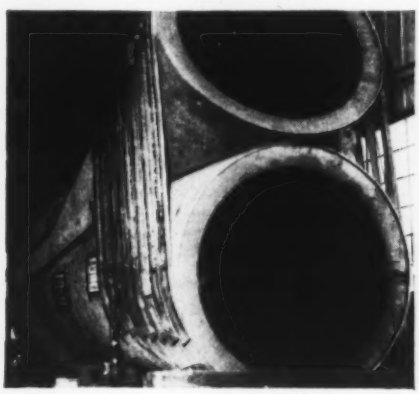
James G. Steese (M. '21), age 75, died in Washington, D. C., on January 11, after a life of service in the Corps of Engineers. Colonel Steese, a graduate of the United States Military Academy,

(Continued on page 106)



Two of four radial gates, and structural steel for river dam project.

Part of 3,000 ton trashrack shipment.



105" Wye for western powerhouse.

provides the engineered fabrication to harness hydroelectric power

As a major source of fabricated and machined components and assemblies – to any geographical location – Yuba offers through Calsteel, Yuba Manufacturing, and Adsco Divisions, a unique combination of experience, skills and facilities. Each has gained prominent recognition for products and services through many decades. Now integrated through Yuba Consolidated Industries, Inc., their combined know-how and facilities are available under a "package responsibility" – with the time-saving economy and convenience of working with a single organization as near as your telephone. Whatever your needs in harnessing the force behind hydroelectric power – you'll like doing business with Yuba. YE-801

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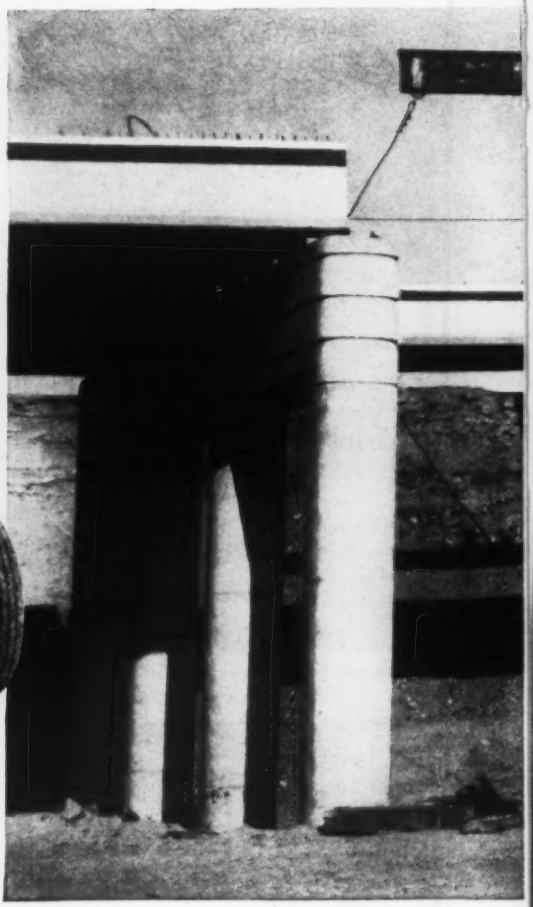
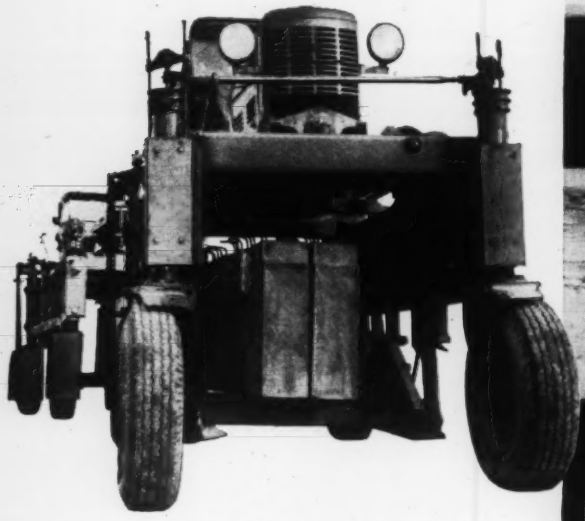
ADSCO DIVISION
Buffalo, New York

PLACING MAIN SPAN GIRDERS—A crane with a spreader beam is erecting a main span girder prestressed with USS American Super-Tens Stress-Relieved Strand. Note the ease of erection.





NEW WAY TO MOVE GIRDERS—Here a straddle truck is transporting a girder from the prestressing plant to the job. This was a time- and money-saving way to transport prestressed girders. Construction was speeded up because the girders were precast, then transported to the job site for immediate erection.

On the Garden State Parkway . . . 405 prestressed

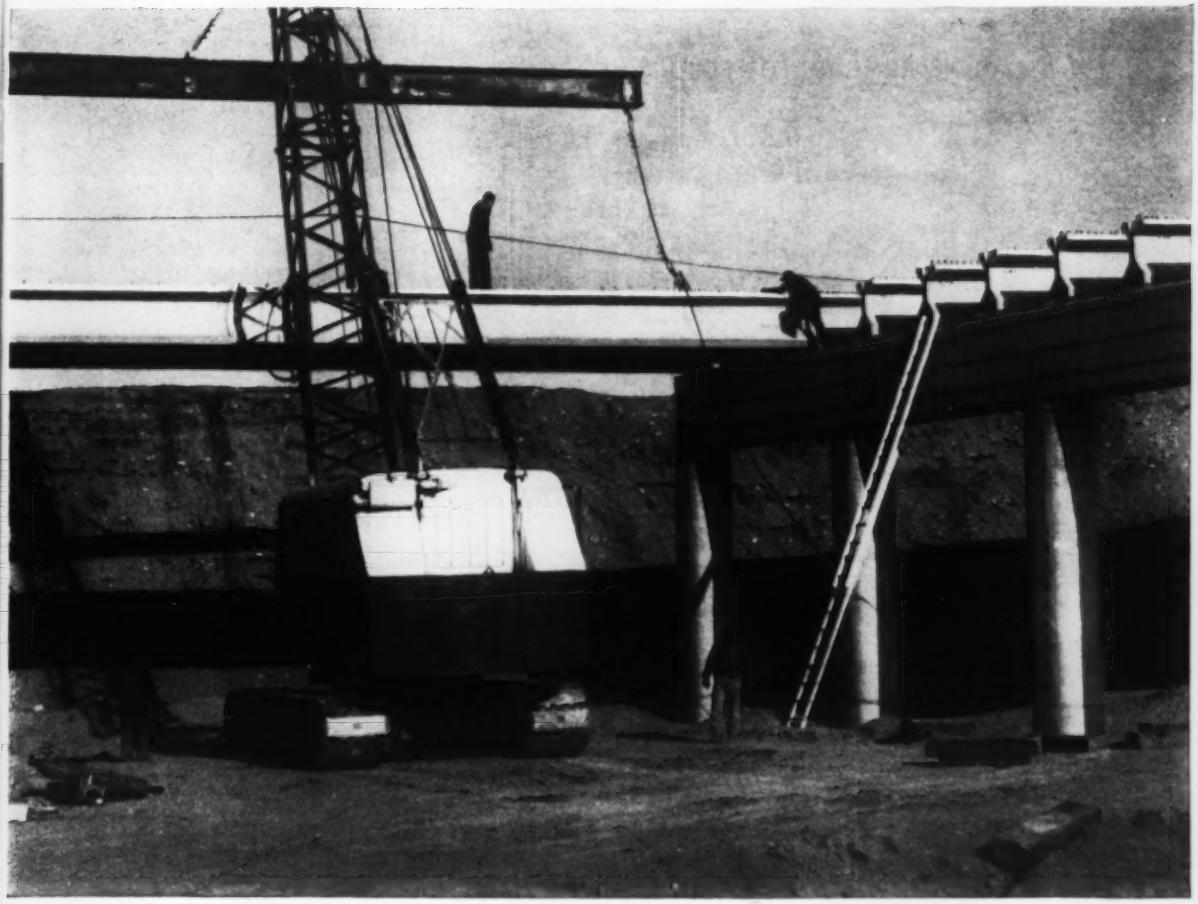
HERE IS the new USS American Super-Tens Stress-Relieved Strand reel furnished in standard sizes of 50" and 44". The new 2-ply construction resists warping and splitting, resulting in longer service life.

Linking New Jersey with New York and New England, the recently completed section of the Garden State Parkway is 9¼ miles of ultramodern highway. Along this new super-road there are eighteen prestressed concrete bridges. USS American Super-Tens Stress-Relieved Strand was used on this modern superhighway development.

The manufacturer of the prestressed beams

USS American

These people built this section of the Garden State Parkway: Design Engineers: Fay, Spofford & Thorndike, Inc., Boston, Mass. • Contractor & Manufacturer of Prestressed Beams: Reid Contracting Company Inc., Woodbridge, New Jersey; L. W. Lancaster, Chief Engineer • Consulting Engineer for Contractor: Charles C. Zollman & Associates, Newtown Square, Pennsylvania.



beams were produced in 81 days

for these bridges produced more than 400 prestressed beams in eighty-one days.

Prestressed concrete is a proven construction material with unlimited possibilities in building roofs, floors, walls, beams, slabs, columns, and foundations, as well as for bridges. American Steel & Wire pioneered in this development in 1951 by being the *first* to develop a new product—special high tensile strength strand for the first pretensioned bridge in this country. Our engineers have much experience in this field, and they will be happy to discuss the application of prestressed concrete to your construction needs.

For more complete details, call our nearest Sales Office today. Or write to American Steel & Wire, Rockefeller Building, Cleveland 13, Ohio.

Super-Tens Stress-Relieved Wire & Strand

American Steel & Wire
Division of USS United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors • United States Steel Export Company, Distributors Abroad

GURLEY

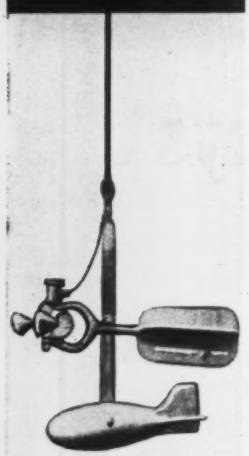
INSTRUMENTS FOR POLLUTION CONTROL

Now—Record Wind Velocity in Any of Three Units

The Gurley Universal Anemometer reads wind velocity—important factor in controlling air contamination—in kilometers per hour; miles per hour; or knots. The three units can be used interchangeably. A simple switch over a calibrator changes the instrument's method of recording from one speed unit to another. The indicator pointer instantly adjusts to the correct reading for the unit selected. The Gurley DC Anemometer is wind-powered...requires no outside power to indicate and record velocity. Accurate within 2% at velocities from about 2 to 100 miles per hour, it is frequently used to control other equipment.

Gurley Anemometers are in wide use at municipal and industrial pollution control laboratories, airports, weather stations, oil refineries, in homes and at shore installations. Other Gurley Wind Instruments for pollution control stations include: Wind Direction Instruments, Wind Velocity and Direction Recorders and Pilot Balloon Theodolites. *Write for Bulletin 6000.*

GURLEY

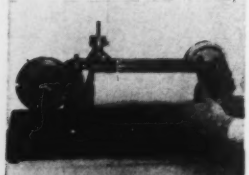


Current Meters, Water Level Recorders Reveal Water Conditions

The study of flow and level of water are two basic steps in controlling pollution of streams and other waters. The basic flow measuring instrument is the Gurley Current Meter, in use in federal, state and municipal bureaus for 70 years. Gurley Current Meters are available in a variety of outfits for use by overhead-cable suspension...wading-rod suspension...exploration and survey parties. Gurley's "Price Pattern" instruments can be supplied in either fresh or salt water models. There is also the "Pygmy" for shallow streams, flumes and canals.

Gurley Water Level Recorders make continuous graphic records for an entire day or week. Float-operated, simple in construction and operation, they are widely used in reservoirs, sewers, sewage disposal and hydro-electric plants, and supplement irrigation and stream gaging measurements. For details on these and many other Gurley Hydraulic Engineering Instruments, write for *Bulletin 700.*

Other Gurley Instruments to aid you in pollution studies include: Densometers for measuring porosity, air-permeability and air resistance of samples; Permeometers for measuring air flow through samples. *Write for further information.*



GURLEY

W. & L. E. GURLEY, 518 Fulton St., Troy, New York

Instrument Makers Since 1845

Deceased

(Continued from page 102)

had served as president of the Alaska Road Commission and executive assistant to the Engineer of Maintenance on the Panama Canal. His specialties were canals and railways, and he was United States delegate to the XIVth International Navigation Congress. In 1945, he received the Legion of Merit for his "exceptionally meritorious conduct" in his work on the Panama Canal.

Thomas F. Sullivan (M. '24), age 79, retired chairman of the City of Boston Transit Department, died recently in South Boston, Mass. For more than fifty years, Colonel Sullivan had served the city of Boston, doing a great deal of work on subways and tunnels. He was in charge of the design and construction of the Huntington Avenue Subway including the Massachusetts Avenue Vehicular Underpass.

Robert S. Treat (A.M. '29), age 59, senior highway engineer on bridge design for the Connecticut State Highway Department, died in Hartford, Conn., on December 4. Mr. Treat studied at the Sheffield Scientific School at Yale University. He served as a designer for steel and concrete mill buildings, warehouses and stores with the Building Department for the state. Mr. Treat had been with the Bridge Designing Section of the Highway Department for more than twenty-five years.

John T. Vawter (M. '18), age 78, chief inspector for Concrete Hulls Company, Oakland, Calif., died recently in Los Angeles. A specialist in design principles and architecture, Mr. Vawter served as architect and engineer with the Ulen & Baker Kellogg Company in Colombia, S. A., and was with the Los Angeles Board of Education for more than ten years. His work with the Board included study of construction and repair of earthquake-resistant school buildings and general work as senior structural engineer. Mr. Vawter had been with the Concrete Hulls Co. since 1944. He was a graduate of the University of Illinois.

Arthur E. Wenige (A.M. '08), age 81, retired dam consultant and supervisor, died recently in Winter Park, Fla. Mr. Wenige, who was graduated from Cooper Institute in New York City, worked for many years in New York. He held the post of chief engineer and president of the Wenige Engineering & Construction Company, Inc. He had been with the Corps of Engineers on the construction of military camps, and consultant on housing and real estate values with the U. S. Resettlement Administration. Later he was active in the building business and in the development of speed control and humidifiers for motor vehicles.

(Continued on page 108)

Have You Seen This?

It's about the NEW

AURORA NON-CLOG HORIZONTAL & VERTICAL MONO-VANE SINGLE PASSAGE IMPELLER PUMPS

The response to our new MONO-VANE Non-Clog Pumps was instant and gratifying. We thought you, too, would find interest in this STEP FORWARD in non-clog pumping technique.

PATENT PENDING

NO SEPARATE COUNTERBALANCE is REQUIRED

Other head and capacity requirements may be obtained by the mere trimming of the impeller. The impeller is ALWAYS in DYNAMIC and HYDRAULIC BALANCE — a major advance in non-clog pumping.

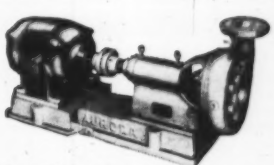
AREAS of APPLICATION

Handles Long Stringy Solids Better than Conventional Non-Clog Impellers • Suited for Industrial By-Products • Semi-Solids • Wastes • Municipal Sewage Plants • Lift Stations • Buildings.

VERTICAL—MONO-VANE PUMPS—HORIZONTAL

Type KU Aurora Vertical Mono-Vane Non-Clog Pump

These advanced pumps with the exclusive Aurora Mono-Vane Impeller are available in both horizontal and vertical types with 3" to 5" (Suction-discharge diam.). Operation is smooth and quiet. Discharge may be turned to various positions. Casings are provided with cleanout opening. Detachable suction and packing covers provide ready access.



Type KGG Aurora Horizontal Mono-Vane Non-Clog Pump

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Your Inquiries Will Receive Prompt Attention

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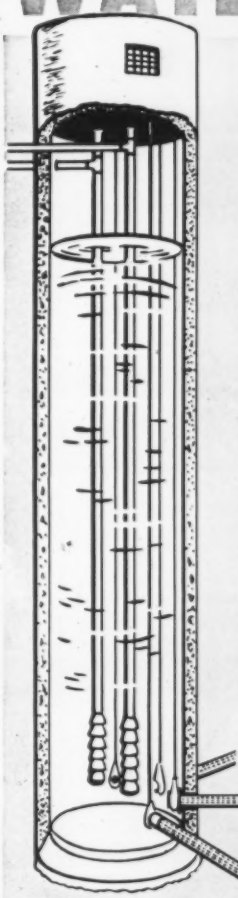
24 years . . . WATER-WISE



"Know how" may seem expensive . . . but, would you call in a plumber to do the job of a consulting engineer?
Profit by doing the job right

From the Rhine to the Mississippi . . . from Canton to Boise . . .

RANNEY METHOD

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- **Unequalled Experience**
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Ranney welcomes the opportunity to work with your consultants on any of your water problems.

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SPECIAL PURPOSE
PREMOLDED
JOINT FILLERS

Here are three widely used special purpose joint fillers—each with specific advantages and characteristics which permit it to provide optimum performance and utility. Complete data and specifications on each type are available upon request.

Sponge Rubber CEMENTONE®

High quality blown sponge rubber, uniform in thickness and density. Neutral gray color blends well with concrete.

advantages

1. Blends with the color of concrete
2. Fully resilient
3. Non-extruding, with high recovery after compression.

recommended uses... For use in concrete structures where utmost resilience, non-extrusion and/or inconspicuous joints are desired. Ideal for use in tilt-up and bridge construction.

SELF-EXPANDING CORK

Similar in composition to Cork Joint, but is specially treated to enable it to expand as much as 50% beyond original thickness.

advantages

1. Fully compressible 2. Non-extruding
3. Will keep joint spaces filled under conditions which open joint to more than original size.

recommended uses...
For use in canal linings and structures, outlet works, spillways, stilling basins of dams, sewage disposal plants and water filtration plants.

CORK

Composed of granulated cork and synthetic resin binder molded under heat and pressure to form a flexible, waterproof filler.

advantages

1. Light in color 2. Compresses without extrusion
3. Recovers approximately 95% original thickness after compression.

recommended uses... Extensively used in flood walls, outlet works and spillways, sewage and water treatment plants, bridge construction.

Want more details on Servicised Joint Fillers. Write for new manual—"The Design and Use of Joints in Concrete Structures."

SERVICISED PRODUCTS
CORPORATION
6051 WEST 65th STREET • CHICAGO 38, ILLINOIS

Deceased

(Continued from page 106)

W. Munsey Wilson (M. '33), age 63, partner in Wilson & Cunningham Consulting Engineers, died recently in Austin, Tex. Mr. Wilson, who held a degree in architectural engineering from the University of Texas, specialized in building and design. As chief structural engineer for Giesecke & Harris, he was responsible for the design and inspection of many buildings, including an Austin hospital. After holding the post of Assistant State Engineer for the Public Works Administration, Mr. Wilson did structural design work in Austin.

News of Engineers

(Continued from page 10)

Three Society members have been named to high posts with the Aluminum Company of America, in the engineering department of its Pittsburgh headquarters. **B. J. Fletcher,** formerly assistant chief engineer, has been named Alcoa's general manager of engineering. Mr. Fletcher joined Alcoa in 1926. Assistant chief engineer **L. B. Kuhns** is the company's new chief engineer. He has been a member of the engineering staff since 1924. **H. F. Robey, Jr.,** formerly assistant chief construction engineer, has been promoted to the post of chief construction engineer. He has been with Alcoa since 1935, and served for some years as construction engineer at the company's Paranam plant in South America.

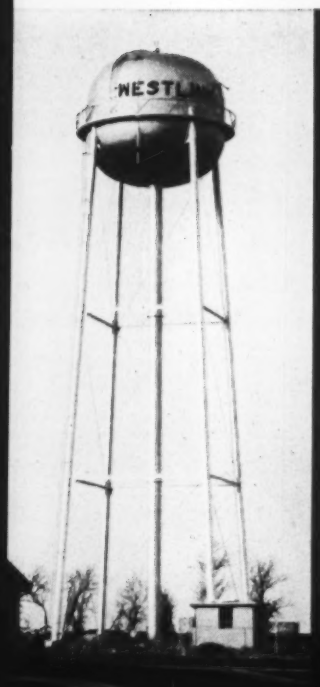
Thorndike Saville, dean emeritus of New York University's College of Engineering, has been named to head a study on the development of the University of Florida's Science and Technology Center. The study will be financed by a $75,000 grant from the Ford Foundation. Dr. Saville retired as dean at NYU in August 1957 to devote more time to his consulting work. He specializes in problems of water resources development and administration. Dr. Saville is currently consultant to the Long Island State Park Commission, engineer member of the New York Public Health Council, consultant on water resources to the New York State Commission on Constitutional Revision, and New York State representative to the Delaware River Basin Advisory Committee.

Dr. T. Saville

B. B. Talley, retired Brigadier General in the U.S. Army, and **Gerald A. O'Connor** have been named vice-presidents of the Raymond Concrete Pile Company. General Talley, who joined the company in 1956, has been in charge of construc-

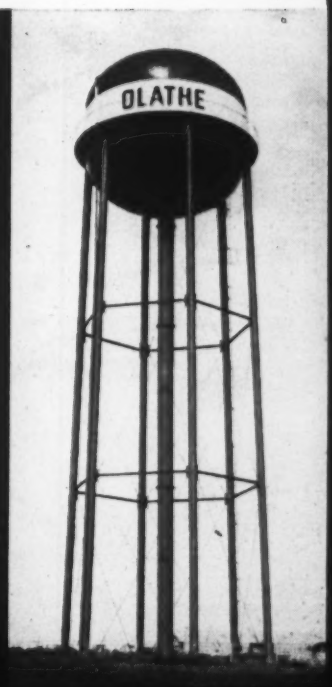
(Continued on page 110)

KANSAS



WICHITA

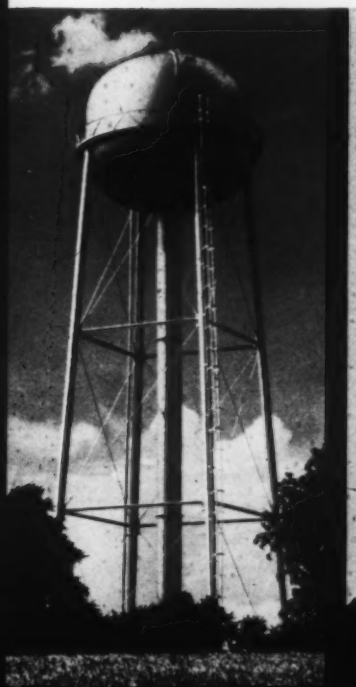
100,000 Gallons
Head Range 21'01"



OLATHE

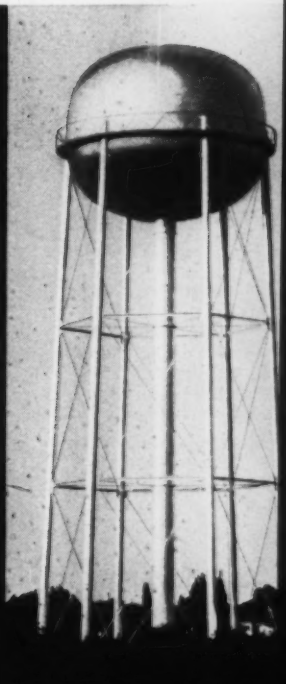
250,000 Gallons
Head Range 30'10½"

WISCONSIN



RACINE

150,000 Gallons
Head Range 24'9¾"



NEENAH

300,000 Gallons
Head Range 30'09"

Some recent examples of Double Ellipsoidal in the very low head-range range

PDM
ELEVATED STEEL TANKS

The low range of head inherent in all PDM Double Ellipsoidal Elevated Steel Tanks is an advantage emphasized particularly in the capacities from 100,000 to 300,000 gallons.

• As illustrated in the installations above, you get low head range *plus* fine appearance in our Double Ellipsoidal design. Let us detail for you the important *economy* factors, as well.

Pittsburgh-Des Moines Steel Company

Plants at PITTSBURGH, DES MOINES, SANTA CLARA, FRESNO, and CADIZ, SPAIN

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NEWARK (2).....1751 Military Park Bldg.
CHICAGO (3)....674 First National Bank Bldg.
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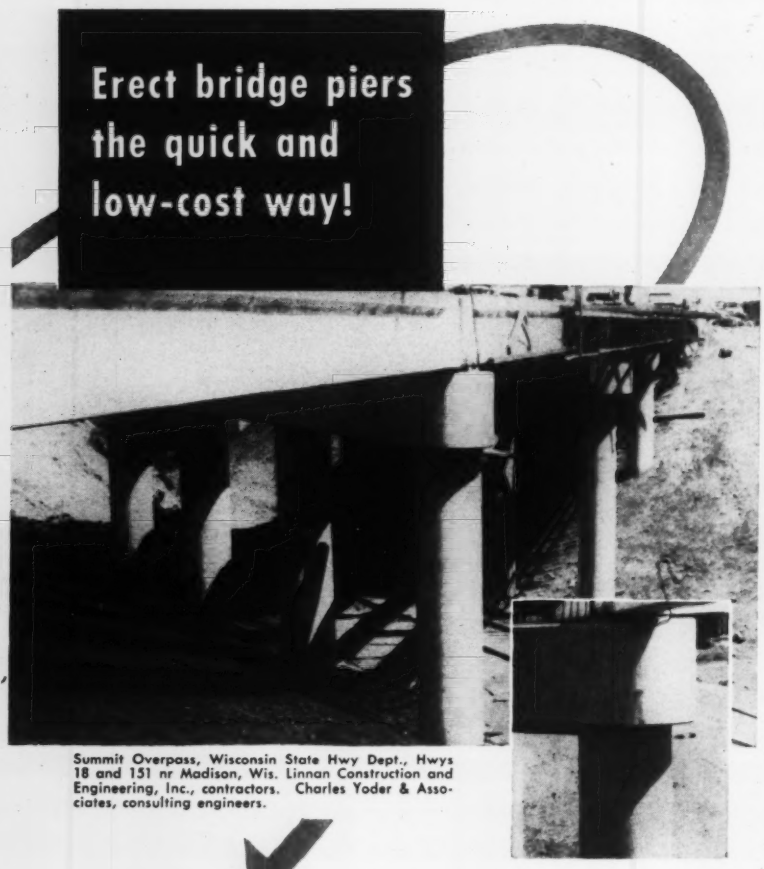
ATLANTA (5).....361 E. Paces Ferry Rd., N. E.
DES MOINES (8).....971 Tuttle Street
DALLAS (1).....1275 Praetorian Bldg.
SEATTLE (1).....Suite 378, 500 Wall St.
SANTA CLARA, CAL.....677 Alviso Road
DENVER (2).....323 Railway Exchange Bldg.



Summit Overpass, Wisconsin State Hwy Dept., Hwys 18 and 151 nr Madison, Wis. Linnan Construction and Engineering, Inc., contractors. Charles Yoder & Associates, consulting engineers.

Form round concrete columns with

SONOCO
Sonotube.
FIBRE FORMS

In this project, 26" I.D. Sonoco Fibre Forms were used to erect the supporting columns.

But whether the structure is a bridge or a building, contractors everywhere have found that Sonoco Sonotube Fibre Forms provide the fastest, most economical method of forming round columns of concrete!

Sonoco forms take less time to erect, require minimum bracing, and are easy to strip. Because of their versatility, low cost and easy handling these fibre forms save you time, labor and money!

Order Sonoco Sonotube Fibre Forms for your next job . . . sizes from 2" to 48" I.D., up to 48' long. Sonoco's patented "A" coated forms are for finished columns. Wax-coated also available.

See our catalog in Sweet's

For complete information and prices, write

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SONOCO
Construction Products
SONOCO PRODUCTS COMPANY

2835

News of Engineers

(Continued from page 108)

tion of Brasilia, the new capital of Brazil, and president of Raymond's Brazilian subsidiary. Before joining Raymond, General Talley was division engineer in the Mediterranean Division of the Corps of Engineers. Mr. O'Connor has been with Raymond since 1929, and has supervised numerous major projects in the Venezuelan area, including the Creole Petroleum Co. offshore storage and loading station in Lake Maracaibo. He was chief executive officer of a number of the company's Venezuelan subsidiaries.

Charles W. Thomas, hydraulic engineer with the U. S. Bureau of Reclamation in Denver, Colo., has just returned from a two-month assignment in Japan. While abroad, Mr. Thomas acted as consultant on the hydraulics of spillways to the Minister of Agriculture and Forestry of the Japanese Government. The assignment was arranged by the Food and Agriculture Organization of the United Nations in cooperation with the Bureau of Reclamation.

C. W. Thomas

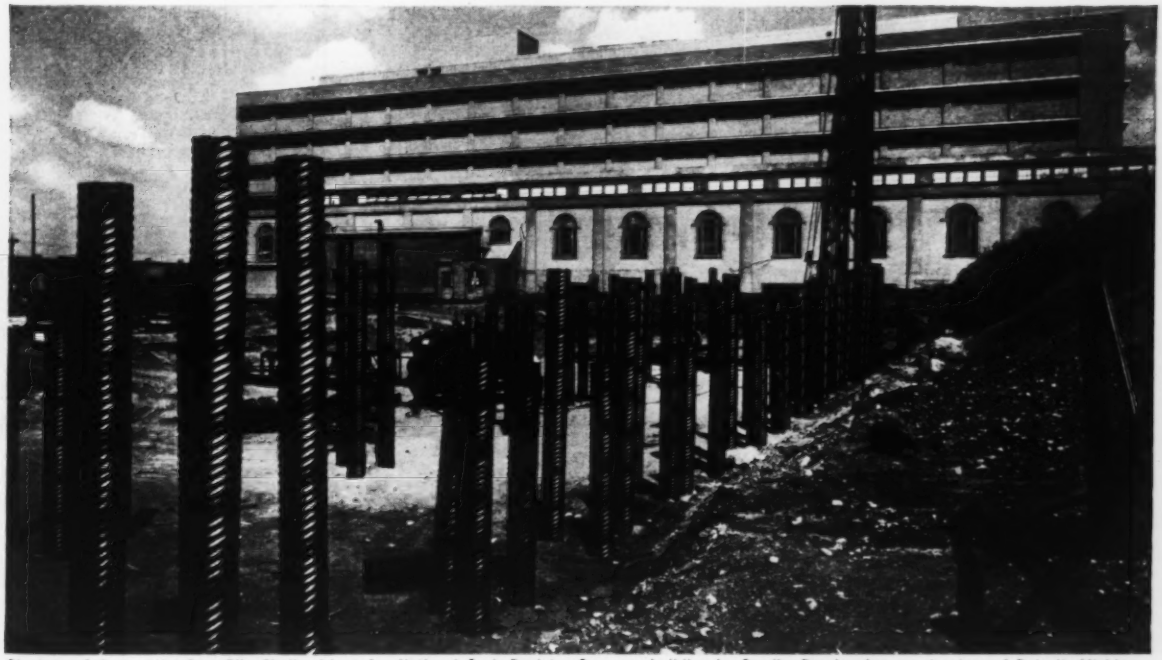
Sigurd Eliassen has recently published a book, *Dragon Wang's River*, concerning his experiences in China. Mr. Eliassen, a consulting engineer with the Norwegian Government Reconstruction Department, was captured by Communist bandits while working on a diversion dam in the Chinese province of Shensi. He was held for ransom, and his story includes his experiences while a prisoner as well as the various problems he encountered in the construction of the dam. This is Mr. Eliassen's first book to be translated into English. It has been published in Oslo, London, and New York. The New York publisher is John Day.

Robert M. Pope has been appointed chief civil engineer for Guy B. Panero Engineers. Mr. Pope has just returned to the firm's New York office after eighteen months in the Middle East. A specialist in water supply and sewage treatment, Mr. Pope had been assigned as project manager of a $66 million public works development program for the government of Iran. The program was a joint engineering venture of Litchfield Whiting Panero Severud & Associates.

Robert M. Pope

Solid foundation on unstable soil

12,000 feet of Armco HEL-COR Pile Shells driven for foundation of new National Cash Register Company building



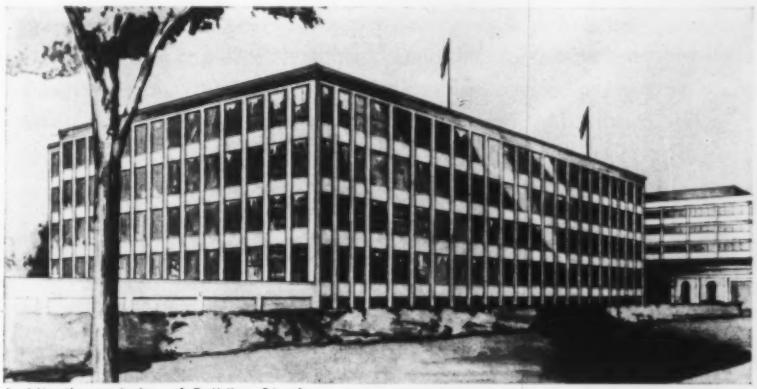
Clusters of Armco HEL-COR Pile Shells driven for National Cash Register Company building by Candler-Rusche, Inc., contractors of Detroit, Michigan.

The site of National Cash Register Company's new Building 31 in Dayton, Ohio, now under construction, was formerly part of the old Miami-Erie Canal. Over the years, a variety of fill material had been deposited there. Consequently, a more stable foundation for the building was needed.

Considering results of numerous test borings and the weight of the completed building, it was decided to use Armco HEL-COR® Pile Shells to provide a good foundation for the structure. The Pile Shells were driven in clusters of 2, 3, and 4, and capped with concrete slabs. In all, 12,000 feet of piling, 12½" O.D., 16 gage, was supplied in 18-, 25-, and 50-foot lengths.

Leading engineers and contractors throughout the country specify Armco Piling and other Armco Construction Products for thousands of large and small construction jobs. There is a size and type of Armco Product to help you solve almost any drainage or construction problem.

Write us for helpful authoritative data. Armco Drainage & Metal Products, Inc., 3978 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.



Architect's rendering of Building 31 of the National Cash Register Company.

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NOW... provide *COMPLETE* containment of water, wastes, brines and sludges with

SEALTIGHT Hydromat ASPHALT LINERS

Pre-fabricated "HYDROMAT" Asphalt Liners provide the ideal liner for all domestic, industrial and recreational facilities where the containment of water, wastes, sludges, brines, etc. demand a very efficient, economical and impervious lining material. "HYDROMAT" is quickly and easily installed as a monolithic liner with mechanically sealed joints . . will expand and contract with soil movements without rupturing or breaking the seal. Installed over (exposed) or under earth, concrete, gunite, steel or other materials... provides the practical answer to the problem of re-lining old, cracked concrete or gunite linings. "HYDROMAT" may be safely used for the containment of potable water in clear well construction and its ruggedness and durability permit its use as a fully exposed lining in large reservoirs to depths exceeding 50 feet. "HYDROMAT" is available in three thicknesses, ½", ¼" and 5/32", in 4' widths and lengths up to 15' . . . longer lengths available on special request.

For complete installation and technical data write today for your copy of the "HYDROMAT MANUAL".

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☐ Have representative call.

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New Publications

Refresher for surveyors . . . Up-to-date reference material for men taking Civil Service engineer-in-training, and professional registration examinations in surveying and civil engineering is provided in a new edition of Prof. Russell Brinker's classic book of questions. Entitled "2525 Review Questions for Surveyors," the new fifth edition introduces typical examinations and permits men studying for registration examinations to determine whether their background has been sufficiently built up in the preliminary material. Copies may be obtained from Prof. Russell C. Brinker, Box 153, Blacksburg, Va. The price is $3.50 for a single copy or $3.00 per copy on orders of five or more copies.

Toll highways . . . Work on the Northern Illinois Toll Highway is reviewed in the Seventh Quarterly Progress Report published by the state Toll Highway Commission. Profusely illustrated, the bulletin deals with construction status, tollway facilities, finance, and economies during the construction stage. Inquiries may be addressed to the Illinois State Toll Highway Commission, 20 North Wacker Drive, Chicago 6, Ill.

Arc welding . . . The second edition of "New Lessons in Arc Welding" is now available from the publisher, the Lincoln Electric Company of Cleveland, Ohio. Based on arc welding courses taught at the Lincoln Arc Welding School, the work is a practical text and excellent reference. Copies may be obtained from the publisher at $1.00 each postpaid in the U. S. A., and $1.50 elsewhere.

Strength of metals . . . Two valuable new publications have been issued by the American Society for Testing Materials. "1956 References on Fatigue" is a listing of about 370 references to articles published in 1956 dealing with fatigue of structures and materials. An abstract of most references is included in the 68-page booklet. "Compilation of Chemical Compositions and Rupture Strengths of Super-Strength Alloys" gives the name, nominal chemical composition, characteristic rupture strength and patentee for about 225 domestic and foreign alloys. The bulletins may be obtained from the Society, 1916 Race Street, Philadelphia 3, Pa.,

Bituminous materials . . . Specifications, test methods, recommended practices, and definitions of terms pertaining to "Bituminous Materials for Highway Construction, Waterproofing, and Roofing" are compiled in a bulletin just released by the American Society for Testing Materials. The sixth edition of the 460-page compilation may be purchased from ASTM Headquarters, 1916 Race Street, Philadelphia 3, Pa., at $4.75 per copy.

Fir plywood . . . "Basic Facts about Fir Plywood Diaphragms," a new booklet of the Douglas Fir Plywood Association, proposes to answer questions on this relatively new design method. The 10-page illustrated brochure presents the results of several years of research and testing by the research and engineering staff of DFPA, the U. S. Forest Products Laboratory, and the Oregon Forest Products Laboratory. Single copies are available upon request from DFPA, Tacoma 2, Wash.

Nailing of subfloors . . . The results of comparative tests performed on various sorts of nails are reviewed in a new bulletin written by E. George Stern, M. ASCE, research professor of wood construction at Virginia Polytechnic Institute. For information write Professor Stern at V.P.I., Blacksburg, Va.

(Continued on page 114)

Paceco first to calculate exact sizes of hydro gate hoists

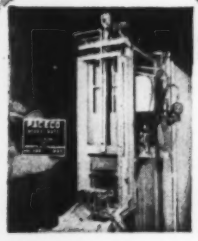
...ASSURING LOWER COST AND GUARANTEED PERFORMANCE!

Paceco tests reduced 540 tons estimate to 390 tons exact requirement

Now, for the first time in engineering history, Paceco has developed a formula to determine the exact downward pressure on water control gates . . . the exact power required from gate hoists.

Pacific Coast Engineering Company has completed a research project in cooperation with the Hydraulic Research Laboratories, Division of Industrial Research, State College of Washington; to determine variables in size and design of gates and hoists for water control; to develop formulae to determine accurate, safe performance. Objectives accomplished!

This research project was conducted in connection with the Paceco contract with Merritt-Chapman and Scott Corporation to furnish a 540-ton capacity crane to simultaneously handle three emergency intake gates at the Priest Rapids Project on the Columbia River. As a result of Paceco's tests, the original estimate of 540-ton capacity requirement has been discarded. 390-ton capacity will serve better, with lower first cost—guaranteed performance!



Downstream view of gate well section showing gate and gate hydraulic control system.

Test apparatus showing air bubble flow pattern for typical gate lip.

PACECO
"TAILORS OF STEEL" ®

Pacific Coast Engineering Company invites your inquiries on cranes, hoists, gates and other similar types of major mechanical equipment. May we put to work for you Paceco's research, designing and fabricating skills? Write for brochure H.

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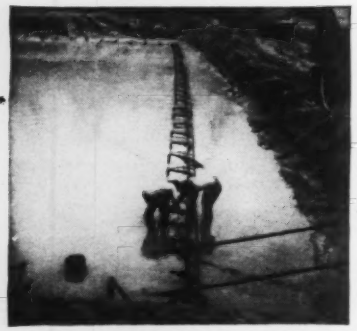
HOW TO HANDLE
WET JOBS

ONE LIFT REMOVES
18 FT OF WATER FROM
"PATCH-QUILT" SOIL

**Sewage treatment plant, Clayton, N. J.
Contractor: C & T Affiliates, Inc.**



SOIL on this job varied by area—fine silty sand here—coarse sand there—gravel a few feet away. This "patch-quilt" pattern precluded routine handling.

GRIFFIN engineers carefully planned proper installation for each wellpoint, using sand filters on some but not others.

This plus other special methods lowered the 18 ft of water with a money-saving single-stage wellpoint system. Top photo shows system placed directly at water level.

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Hammond, Ind. Houston, Tex. Jacksonville, Fla.

In Canada: Construction Equipment Co., Ltd.
Toronto Montreal Halifax

New Publications

(Continued from page 112)

Pollution control, bibliography . . . A valuable new "Handbook of Selected Biological References on Water Pollution Control, Sewage Treatment, and Water Treatment" is now available. The U. S. Department of Health, Education, and Welfare is the publisher of this revised 1957 edition, written by William M. Ingram and identified as Public Health Service Publication No. 214. Copies may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Wash. 25, D. C., at 45 cents per copy.

Wood research . . . Four new bulletins have been added to the list of publications offered by the Wood Research Laboratory of Purdue University: "Nail-Glued Roof Trusses from Low-Grade Hardwood Lumber," by Donald H. Perceval; "How to Select Hardwood Lumber for Structural Nail Gluing," by Stanley K. Suddarth; "How to Nail-Glue Hardwoods and Softwoods," by Hugh D. Angleton; and "How to Build a 40-Foot Clear-Span Trussed-Frame," by W. H. Friday, A. C. Dale, R. H. Perkins, and S. K. Suddarth, are currently available. For information write the Wood Research Laboratory, Agricultural Experiment Station, Purdue University, Lafayette Ind.

Research . . . The Engineering Experiment Station of Purdue University announces publication of Research Bulletin No. 136, "Report of Research Activities of the Engineering Schools and Departments for the Session 1956-1957." The bulletin is available free of charge from the Engineering Experiment Station, Purdue University, Lafayette, Ind.

Highway research . . . Two timely bulletins have just been released by the Highway Research Board. "Concrete Pavement Construction and Winter Construction of Bridges," issued as Bulletin No. 162, contains three papers on preparation of plans, past procedures on pavement construction, and the use of insulated forms. Bulletin No. 163, entitled "Night Visibility," is composed of four papers on visibility, highway lighting, safe stopping distances at night, and visibility of reflectorized license plates. Bulletins are available from the Board, 2101 Constitution Avenue, Washington, D. C., at 60 cents and 80 cents, respectively.

Concrete inspection . . . The newest edition of the pocket-size "ACI Manual of Concrete Inspection" is now ready for distribution. This fourth edition contains 240 pages of descriptive material on the problems and techniques of inspection and latest construction methods. Copies at $3.50 each are available from the American Concrete Institute, P. O. Box 4754, Redford Station, Detroit 19, Mich.

National Science Foundation . . . The Foundation announces availability of all its publications issued to date. Address request for lists of publications to Publications Office, National Science Foundation, Washington 25, D. C.

Highway engineering . . . New highways should be used to divide cities into "man-sized" neighborhoods" is the thesis of Bulletin No. 31 of the Urban Land Institute. The 92-page publication, just released, contains transcripts of papers prepared for a symposium on "New Highways: Challenge to the Metropolitan Region," sponsored by the Connecticut General Life Insurance Company. Copies at $3.00 each are available from the Institute, 1200 Eighteenth Street, N. W., Washington 6, D. C.

Masonry testing bibliography . . . An annotated bibliography, providing a background of the literature of masonry testing for use by engineers and architects, has been prepared by Louise Gray, of the University of California, under sponsorship of the State of California Department of Public Works. Address inquiries to the University of California, Los Angeles, Calif.

Research reactors . . . With research reactors finding increasing application in advanced education in nuclear science and engineering, and in nuclear research, two new Atomic Energy Commission bulletins are particularly timely and valuable. "U. S. Research Reactors" provides a compact summary of technical information on major types of research reactors developed in the United States. It is available from the Office of Technical Services, U. S. Department of Commerce, Wash. 25, D. C., at $1.50 per copy. Also available is a publication containing papers presented at the AEC's recent Engineering Test Reactor Industrial Preview at Idaho Falls (November issue, page 100). For information write the AEC Idaho Operations Office, Idaho Falls, Idaho.

Federal research . . . The National Science Foundation has released a report on the federal research and development budget for 1957. The estimated expenditures in various fields are reported in "Federal Funds for Science VI," which is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. The price is 35 cents a copy.

Steel products . . . Two newly revised manuals in the American Iron and Steel Institute's continuing series are hot off the press. "Flat Rolled Electrical Steel," a revision of the March 1956 edition, covers terminology, manufacturing methods, standard types and their properties, finishes, and treatments. The second bulletin "Carbon Steel Sheets," revised from the June 1954 issue, contains information on metallurgical aspects, manufacturing methods, quality descriptions, chemical composition, and tolerances. Information from the Institute, 150 East 42 Street, New York 17, N. Y.

Acid mine drainage . . . Results of a research project on Ohio stream pollution by acid water from coal mines, and suggested solutions to the problem, make up Bulletin No. 166 of the Ohio State University Engineering Experiment Station. The report is available from the Engineering Experiment Station, Ohio State University, Columbus 10, Ohio, for $2.00.

Seismology, bibliography . . . A selected bibliography on earthquake resistance design has been compiled by the American Institute of Steel Construction. The bulletin lists publications on seismology, the magnitude and intensity of earthquakes, and engineering applications. Copies are available from the American Institute of Steel Construction, Inc., 101 Park Avenue, New York 17, N. Y.

Underground structures . . . Methods of design and construction of "Tunnels, Underground Structures, and Air-Raid Shelters" are considered in a new bulletin by A. A. Eremin. Copies, at $5.00 each (post-paid), may be purchased from the author, 1541-x 37th Street, Sacramento 16, Calif.

Safety . . . Part One of a projected three-part series on Safe Loads and Properties is available from the author, Anthony d'O Smith, 17 Grosvenor Road, Richmond, Surrey, England. The bulletin, which covers applications to Square-Tied Columns, includes design tables for standard reinforced concrete columns. The price is 3s9d. Part Two, dealing with safe loads and properties for rectangular tied columns, will be issued soon.

Water quality criteria . . . The meaning, significance, and expression of more commonly measured water quality criteria and potential pollutants are the subject of Bulletin No. 58 just released by the Engineering Experiment Station at Louisiana State University. Robert B. Brown, associate engineer at the Station is the author. The proceedings of the recent Sixth Annual Water Symposium, held at the university, comprises Bulletin No. 59. Inquiries about both should be sent to the Engineering Experiment Station at Louisiana State University, Baton Rouge, La.

(Continued on page 116)

"Completed on time"

Reinforced concrete viaduct carrying Rhode Island State Route 116, The George Washington Highway, over the Blackstone River Valley. Designed by the Rhode Island Division of Roads and Bridges.

There were no delays with

REINFORCED CONCRETE

CONCRETE REINFORCING STEEL INSTITUTE
38 South Dearborn St., Chicago 3, Illinois

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Bridges and highway separation structures are open for traffic on time when you design in reinforced concrete. Materials and labor are *on location*—ready to start and proceed to completion. Furthermore, with reinforced concrete, necessary field changes can be made without costly delays.

Reinforced concrete is a highly flexible medium of construction. Many complicated curves can be obtained at moderate cost with simple, field-built forms. Structures of reinforced concrete are lower in first cost and require less maintenance.

Compare—you will save with Reinforced Concrete!

A sign of efficiency

for every type of building

Wherever you see Kinnear Rolling Doors, you can be sure there's a high level of efficiency in handling plant traffic — plus other important advantages.

The coiling upward action of the *Kinnear-originated* interlocking steel-slat door curtain makes all space around the door fully usable all the time.

Kinnear Motor Operators add quick, easy, push-button control to this efficiency. They permit you to control any number of doors from a single point, or each door from any number of points.

This cuts traffic delays and bottlenecks and promotes *prompt* door closure, reducing loss of heated air in winter, cooled air in summer.

In addition, Kinnear Rolling Doors assure extra all-steel protection against wind, weather, fire, intrusion and vandalism.

You can't beat Kinnear's 60-year record for providing long, low-cost, dependable door service under hardest daily use. Kinnear Rolling Doors — built to fit any opening — are easily installed in old or new buildings.

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ROLLING DOORS
Saving Ways in Doorways

Heavily Galvanized! 1.25 oz. of pure zinc per sq. ft. of metal (ASTM Standards) gives Kinnear Rolling Doors **lasting** protection from the elements. Special Kinnear Paint Bond permits paint to be applied immediately after doors are erected, assuring thorough coverage and lasting adhesion.

The KINNEAR Mfg. Co.
Offices and Agents in All Principal Cities

FACTORIES: 1080-90 Fields Ave., Columbus 16, Ohio; 1742 Yosemite Ave., San Francisco 24, Calif.

New Publications

(Continued from page 114)

Snow Cover . . . Two detailed analyses of Canadian snow cover characteristics have been made available by the National Research Council of Canada. The studies—"Some Results of the Snow Survey of Canada," by L. W. Gold and G. P. Williams, and "An Analysis of Snow Cover Characteristics at Aklavik and Resolute, Northwest Territories," by G. P. Williams, are available at 25 cents each from the Council's Division of Building Research, Ottawa, Canada.

Parking . . . Progress in the solution of local and national parking problems is reviewed in a recent Eno Foundation publication entitled "Parking." Written by Robert H. Burrage and Edward G. Mogren, the 400-page publication deals with all phases of the parking problems and methods of control. Information from the Eno Foundation for Highway Traffic Control, Saugatuck, Conn.

Structural investigation . . . "The Structural Behavior of Hoover Dam" by Joe T. Richardson, is a report based on information obtained from strain meters embedded in the mass concrete, and correlation deflection measurements from precise surveys. Several types of instruments were installed in the dam for the purpose of measuring the action of the structure during both construction and its operation under load conditions. Inquiries should be sent to the Foundations and Structural Behavior Section, Dams Branch, Commissioner's Office, Bureau of Reclamation, Denver, Colo.

Positions Announced

Pan American Sanitary Bureau. Vacancy exists for Public Health Engineer to serve as Chief of Environmental Sanitation Branch at headquarters in Washington, D. C. Applicant must show graduation with civil engineering degree, sanitary engineering degree, or equivalent experience in environmental sanitation; at least ten years experience in environmental sanitation programs; and demostrated ability to plan and supervise public health programs. Fluency in English and working Spanish required. For salary and full details write to Personnel Officer of the Bureau, World Health Organization, 1501 New Hampshire Avenue N.W., Washington, D. C.

Chico State College. Opening for a civil engineer to teach basic civil engineering subjects in a four-year program. Current graduates of high standing will be considered. For further information write to President Glenn Kendall, Chico State College, Chico, Calif.

Sacramento State College. Opening for instructor or assistant professor in civil engineering to teach senior courses in sanitary engineering and city planning and to assist generally with other civil engineering courses. Ph.D. or M.S. required plus practical experience. Position opens September 1958. Contact the Dean of the College, Sacramento State College, Sacramento, Calif.

ARE YOU FLOWING YOUR MONEY AWAY?

Reduce Plant Operating Costs with Builders "Bubble-Tight" Butterfly Valves!

Flowing water represents money . . . your money, your client's money, or the community's money! Protect your investment by investigating these operating economies of Builders Butterfly Valves.

BUILDERS AWWA BUTTERFLY VALVES *prevent* . . .

- **Loss of valuable water through faulty seating.**
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"Bubble-Tight" Butterfly Valves backed by Builders specialized knowledge of water and sewage works metering and control problems, offer many exclusive design features which can save you money. Request Bulletin 650-L1B for money-in-your-pocket details.

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"Cross-Sectional configurations have been found to have an influence on watertightness" *

TESTS PROVE CROSS-SECTION DESIGN OF DURAJOINT WATERSTOP TO BE FAR SUPERIOR!

A series of tests have been conducted by the Ontario Research Foundation in order to determine how the functional performance of DURAJOINT Waterstops, 4" and 6" wide, will compare to the functional performance of Dumbell Type Waterstops, 6" and 9" wide, when embedded in concrete and subjected to hydrostatic pressures of various magnitudes.

These tests provided many interesting and important results . . . it takes the right combination of PVC material and multiple-ridge cross-section design, found only in DURAJOINT, to stop water under all joint conditions that are likely to exist . . . the 4" wide DURAJOINT Waterstop is far more effective than the 6" wide Dumbell Type Waterstop and the 6" wide DURAJOINT Waterstop is also far more effective than the 9" Dumbell Type Waterstop.

DURAJOINT and DURASEAL Waterstops are strong, flexible, lightweight, easy to install . . . all types of joints, such as tee, box, cross-joints, overlapped and butt splices may be quickly and easily made on-the-job without the use of special equipment or skilled labor.

Be sure to investigate these interesting results yourself . . . just mail the coupon (below) today, for your free copy of Technical Report No. 4 that contains complete technical data, as to how the performances of waterstops compare, plus actual copies of the test reports. If you are interested in watertight waterstops, this report should prove to be one of the most interesting technical manuals you've ever read.

* Journal of American Concrete Institute, Discussion 52-7, V. 28, No. 6, Dec. 1956, Part II, Proceedings V. 52, Page 1151

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Non—ASCE Meetings

American Concrete Pipe Association. Fiftieth Anniversary Convention at the Roosevelt Hotel, New Orleans, La., week of March 9. Information from the Association, 228 North La Salle Street, Chicago 1, Ill.

American Congress on Surveying and Mapping and American Society of Photogrammetry. 1958 Consecutive Meetings and Co-Exhibit at the Shoreham Hotel, Wash., D.C., March 23-29. Write ACSM-ASP, 1515 Massachusetts Avenue, N.W., Wash., D. C.

American Institute of Chemical Engineers. Fourth Nuclear Engineering and Science Conference at the Chicago International Amphitheatre, Chicago, Ill., March 17-21. For information contact Joel Henry, Congress Manager, American Institute of Chemical Engineers, 25 West 45 Street, New York 36, N. Y.

American Institute of Steel Construction. Tenth Annual National Engineering Conference at the Chase-Park Plaza Hotel, St. Louis, Mo., on April 17 and 18. For details write AISC, 101 Park Ave., New York 17, N. Y.

American Water Works Association. Annual conference, April 20-25, at the Adolphus, Baker, Dallas, Statler-Hilton, and White-Plaza Hotels in Dallas, Tex.

American Welding Society. Annual meeting and Welding Show in St. Louis, Mo., April 14-18. For information write American Welding Society, 33 West 39 Street, New York 18, N. Y.

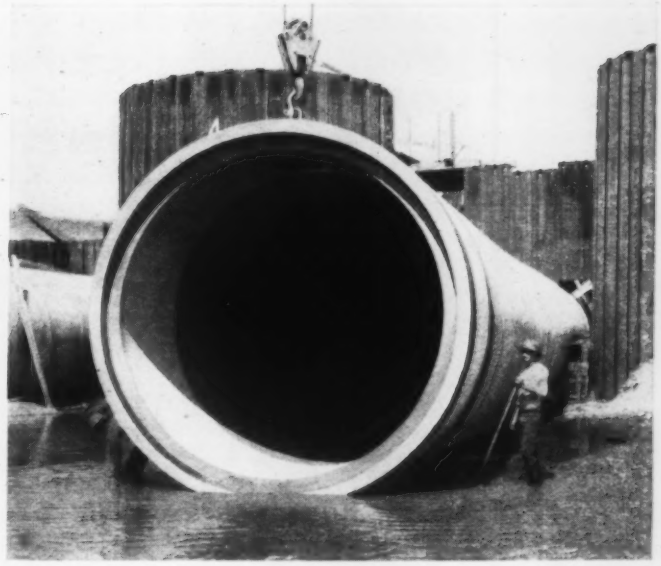
Building Research Institute. Seventh Annual Meeting at the Shoreham Hotel, Wash., D. C., April 21-23. Information from the Institute, 2101 Constitution Ave., Washington 25, D. C.

Fédération Internationale de la Précontrainte. Third International Prestressed Concrete Congress, May 10, at the Benjamin Franklin Congress Hall, Zeltenalee, Berlin-Tiergarten, Germany. Information from Congress Secretary Ing. P. Misch, Deutschen, Beton-Verein 61 Bahnhofstrasse, Wiesbaden, P. O. Box 543, Germany.

Seventh Southern Municipal and Industrial Waste Conference. Sponsored by the College of Engineering, Duke University, the University of North Carolina, and North Carolina State College, **May 1 and 2,** on the Duke campus in Durham, N. C. Information from the university.

Third U. S. National Congress of Applied Mechanics. At Brown University, Providence, R. I. on June 11-14. For information write Miss E. M. Addison, Box F, Brown University, Providence 12, R. I.

BIG



CONCRETE PIPE BY AMERICAN-MARIETTA

American-Marietta 144" reinforced concrete pipe installation used by Ohio Edison Co. for a triple discharge line over 1000 feet long at Stratton, Ohio.

A-M trucks delivering concrete pipe directly to the job site. Nationwide location of plants assures quick delivery of your order by truck, rail or barge.

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RECENT BOOKS

Digital Computer Components and Circuits

This basic text by R. K. Richards is aimed at the student or practicing engineer, and emphasizes basic engineering approaches to digital techniques. A wide range of components and circuits of an experimental nature is covered, as well as logical functions and digital storage, basic operations to be performed by a digital computer, and the advantages and disadvantages of various approaches to design. Design concepts are stressed rather than specific design details. D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, N. J., 1957. 511 pp., $10.75.

Engineering Materials Handbook

This is a very thorough reference book that emphasizes fabricated forms of materials, their physical and mechanical properties, their advantages and limitations, protection against deterioration, and increase in their stability to withstand use and abuse. The subject matter is divided into four parts: metals, inorganic materials, organic materials, and the prevention of failure. A feature of the book, edited by Charles L. Mantell, is the attention given to uncommon metals. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1958. Various pagings, $21.50.

History of Hydraulics

The authors, Hunter Rouse and Simon Ince, have chosen as their historical theme the formulation of the underlying principles of fluid motion. Considerable attention is given to the men who bore the brunt of the development and to their related interests and accomplishments. In general the subject of hydraulics is not treated as an isolated phenomenon but is placed within its proper historical perspective beginning with antiquity and progressing to the twentieth century. Iowa Institute of Hydraulic Research, State University of Iowa, Iowa City, Iowa, 1957. 269 pp., $5.00.

Materials Handling Handbook

This new handbook, edited by Harold A. Bolz, is concerned with efficient and economic handling of materials in raw, in-process, or finished form. Methods for analyzing handling problems are treated; principles and techniques for effective operation and control; systems design and installation; integration of materials handling activities with the manufacturing processes; and the design, selection and classification of materials handling equipment. This equipment is analyzed in relation to the engineering specifications and the operating capabilities of each type. The Ronald Press Company, 15 East 26th Street, New York 10, N. Y., 1958. Various pagings, $20.00.

Midwestern Conference on Fluid Mechanics

The proceedings of the Fifth Conference, April 1957, is a collection of twenty-six papers which represent basic research in many aspects of fluid mechanics. Included are papers on basic and applied problems in free surface phenomena, heat transfer and skin friction in laminar and turbulent boundary layers, stability of flows, viscosity, shock wave and dissociation effects in supersonic and hypersonic flows, and other fields. Published for the Engineering Research Institute by the University of Michigan Press, Ann Arbor, Mich., 1957. 388 pp., $8.00.

Midwestern Conference on Solid Mechanics

Proceedings of the Third Conference, April 1957

Fifteen papers devoted to basic research in the area of solid mechanics cover elasticity, plasticity, properties of viscoelastic media, wave propagation, structural dynamics, stability of rotors, flutter of aircraft components, and structures. The authors are connected with governmental and industrial research laboratories. Published for the Engineering Research Institute by the University of Michigan Press, Ann Arbor, Mich., 1957. 250 pp., $5.50.

Miracle Bridge at Mackinac

The story of the construction of the Mackinac bridge, is told by the engineer who designed it, David B. Steinman. Purely technical factors have been avoided in the writing, but the reader is given an indication of the myriad of problems that were encountered in building the longest, costliest and safest suspension bridge in the world. Some of the difficulties faced are revealed by its center span which is 3800 feet long, towers which are 552 feet above the water and cables that are two feet in diameter. The story of its creation is a tribute to its engineer, Wm. B. Eerdmans Publishing Co., Grand Rapids, Mich., 1957. 208pp., $4.50.

The Modern Port

The aim of the author, H. Fugl-Meyer, is to provide technical guidance in solving problems concerning the planning, construction, and ad-

(Continued on page 124)

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Men Available

CIVIL ENGINEER, A.M. ASCE; B.S. in C.E.; 40. 13 years' experience, structural, sewer, water, design and supervision; 4½ years' partner in consulting firm, 3½ years' in charge of county road department. Location: Open. C-307-809-San Francisco.

CIVIL ENGINEER, J.M. ASCE; B.S.; 32. 1 year draftsman detailer; 6 months' surveying and right of way in toll road construction; 6 months' in structural design in timber structures; 1½ years' in building and bridges structure design. Surveying or structural work. Location: Open. C-308.

CIVIL ENGINEER, A.M. ASCE; married; 37. 12 years' experience in design and construction of buildings and housing. 9 years' in Latin America. Desires position as designer, resident engineer, or superintendent of construction in Florida, California or two year foreign assignment. Speaks Spanish. C-309.

CONSTRUCTION ENGINEER, J.M. ASCE; B.S.C.E.; 28. 4 years' resident engineer, industrial buildings. Responsible for all phases of construction. Supervision, co-ordination, and inspection of foundations, structural steel, reinforced concrete, masonry, etc.; installation of manufacturing equipment. Desires responsible position with opportunity. Location: Northeastern United States. C-310.

CIVIL ENGINEER, J.M. ASCE; graduate; 27. Registered land surveyor, S.C.; registered engineer-in-training, S.C.; 6 years' experience in engineering surveying. Desires position that will give experience in sanitary and hydraulic engineering. C-311.

CIVIL ENGINEER, J.M. ASCE; B.C.E.; 27. 2 years' bridge construction experience, as assistant resident engineer; 3 years' administrative engineering experience as commissioned officer in the Civil Engineer Corps. Location: East. C-312.

SOILS AND MATERIALS ENGINEER, A.M. ASCE; single; 39. Highly qualified; over 8 years' office and field experience. M.S. in soil mechanics and in highway engineering; special experience in soils and foundations. Registered P.E. Illinois and Pennsylvania. Available in April, 1958. C-313.

CONSTRUCTION ENGINEER, J.M. ASCE; B.S.C.E.; 34. 1 year structural design; 8 years' field engineering in steel, chemical, paper and equipment manufacturing plants. Location: U. S. or foreign. C-314.

CIVIL ENGINEER, J.M. ASCE; B.S.C.E.; single; 29. Registered P.E. in Illinois; 6 years' diversified experience, including water and sewers, city streets, county highways, water treatment plant, topographic mapping, line surveys and property surveys; available in March, 1958. Location: Midwest-West. C-315-862-Chicago.

CIVIL OR STRUCTURAL ENGINEER, J.M. ASCE; B.S.C.E.; M.S.C.E.; 28. 2 years' field experience with highway bridge department; 2 years' commissioned officer, Corps of Engineers, including supervision of design office, Korea; 2 years' design and field supervision of bridges for consultant; 2 years' senior structural designer, major industrial structures. Desires supervisory position, advancement likely. C-317.

CIVIL ENGINEER, A.M. ASCE; M.S.C.E.; 33. Registered professional engineer. Experienced in foreign work, sanitary engineering, teacher of civil engineering at a State University; has set up soils testing laboratories and testing soils; superintendent of construction. C-318.

ENGINEERING MANAGER for commercial, industrial or consulting firm. A.M. ASCE; B.S.C.E.-M.I.T.; 36. 15 years' experience civil and structural design in industrial and consulting fields. 6 years' as chief engineer and associate in architect-engineer organization. Thorough knowledge of design, specifications, contracts and labor relations. Registered P.E.; national certification. Location: southern U. S. or East. C-319.

CONSULTANT, J.M. ASCE; B.S.C.E.; 9 credits post-grad. work; 26. 1 year varied field experience reinforced concrete and steel; structures. 4 months' field engineer for construction company; surveyor for city engineer and public utility on earth fill dam. 2 years' assistant professor U. S. Naval Academy, fluid mechanics, thermo, aerodynamics. Engineering training in Nevada and California. Location: West, Midwest, East. C-320.

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Positions Available

INSTRUCTOR, M.S., for civil engineering department, to teach fluid mechanics, sanitary engineering and surveying. Salary, to $6,500 for 9 months. Position available September, 1958. Location: Ohio. W5711.

ASSISTANT DIRECTOR, young, civil engineering background, with a year or more experience in planning or training, and an interest in traffic problems. Salary, $6,000 a year. Location: New Jersey. W5715.

ARCHITECTURAL ENGINEER, graduate, with 4-5 years' experience on commercial and industrial buildings; some creative ability; able to carry project thru with little supervision. Salary, $8,000-$9,000 a year. Location: north central Pennsylvania. W5731.

CIVIL ENGINEER, graduate, with railroad experience on terminal type facilities, for both field and office work on studies, reports and design of both railroad and industrial facilities and grade separation work. Salary, $7,800-$9,000 a year, plus fringe benefits. Location: deep South. W5759.

WATER WORKS ENGINEER, civil graduate, for design and layout of water supply systems, filtration plants, and pumping stations. Salary, $6,000 a year. Location: New York, N. Y. W5769.

ENGINEER, with municipal engineering experience. Must be executive administrator type with good engineering background, who is well acquainted with sewerage, roads, etc. Will be in charge of building departments, sanitation and road work. Salary open. Location: New Jersey. W5771.

(Continued on page 125)

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HENRY JOSEPH JOHNSON, Guantanamo Bay, Cuba.
ANDREW SAMUEL KAHAN, Haifa, Israel.
ROBERT WALES KELLEY, Baytown, Tex.
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Recent Books

(Continued from page 120)

ministration of harbors. About half the book is devoted to cargo-handling equipment and methods; the rest gives basic information on basins, quays, port structures, storage systems, transit facilities, and a special chapter on fishing ports. Danish Technical Press, Copenhagen, Denmark, 1957. 202 pp., D. Kr. 22.50.

Once Round the Sun: The Story of the International Geophysical Year

Because of the importance of the sun in the study of geophysics, the author, Ronald Fraser, discusses various phases of the sun's behavior and its effect on the earth, including earthquakes, terrestrial magnetism, the movements of the oceans and the great air masses, the auroras, and the melting of glaciers. The program of the International Geophysical Year is covered in detail: the 24 hour watch on the sun, the oceanographic program and the concentration of stations throughout the earth. A two-page conclusion is a summary of what the program hopes to achieve. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y., 1957. 160 pp., $3.95.

Raft Foundations: The Soil-Line Method of Design
Third Edition

This volume by A. L. L. Baker, is planned to give engineers a method of raft design that takes into account variations in soil pressure. Recent advances have provided more information concerning means of arriving at the value of the modulus of elasticity of the soil, which in turn has given more precision to the use of this method. Present methods of raft design are discussed and followed by a detailed analysis of the soil-line method. The conclusion then deals with examples of the applications of this method and with determination of the coefficient of subgrade reaction. Concrete Publications, Ltd., London, England, 148 pp., 1957. $2.80.

References on Fatigue, 1956
Special Technical Publication No. 9-H

A list of approximately 370 references to articles published in 1956 dealing with fatigue of structures and materials. The complete set of references covers references to articles published from 1870-1956. Published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1957. 64 pp., $3.00; Complete set, 9-B—9-H, $10.00.

Schalung Und Rustung

This well-illustrated survey of modern developments in forms and scaffolding for concrete structures, is intended for the practical construction engineer or designer or the student who is already familiar with the basic treatment. Author Franz Böhm presents a critical discussion of construction possibilities, and considers the economic aspects and the organization of building site operations. This fourth edition is edited by N. Labutin. Wilhelm Ernst & Sohn, Berlin, Germany, 1957. 211 pp., DM 36.

Schrifttum Uber Bodenmechanik II
Bibliography on Soil Mechanics II

Supplementing the first volume which covered the literature up to 1950, Hans Petermann's present volume brings the coverage up into 1955, including a number of pre-1950 items which were not in the previous compilation. The references are grouped in broad classifications, such as soil characteristics, properties, and testing, soil statics and dynamics, groundwater, foundation engineering, road and railway construction. The preface, introduction, and contents are given in German, English, and French; a combined author and title index is provided; and a decimal classification is applied to the German contents page. Published as Forschungsarbeiten aus dem Strassenwesen, Neue Folge, Band 32, by Kirschbaum Verlag, Bielefeld, Germany, 1957. 251 pp., DM 20.

Statically Indeterminate Structures

Samuel Napp presents a new method of analysis for statically indeterminate structures based upon the elastic theory. The method the author describes is a modified form of the principle of the moment area, and is referred to as the method of the angular rotation. The application of the principles of the moment area to angular rotations and deflections is dealt with preliminary to an analysis of continuous beams of uniform or varying moments of inertia. This is followed by an analysis of several types of symmetrical rigid frames loaded symmetrically, while the remainder of the book discusses rigid frames. Published by Rae Napp, 1749 Grand Concourse, New York 53, N. Y., 1957. 291 pp., $10.00.

Statik Und Dynamik Der Schalen
Second Edition

The statics and dynamics of shells are comprehensively treated by Wilhelm Flügge. Major topics covered are as follows: membrane theory of cylinders and of shells having the form of surfaces of revolution; general membrane theory for arbitrary shell types; bending theory of the most important shell types; buckling of thin shells; and shell vibrations. The book also includes a section on stress measurements in reinforced concrete shells and an outline of the theory of prismatic structures. Published by Springer-Verlag, Berlin, Germany, 1957. 286 pp., DM 28.50.

Technical Report Writing

A concise, practical treatment approaches the subject as a design problem, and relates report form to the use to be made of the report. James W. Souther takes up the major aspects of the subject in a logical manner: determining the purpose, industrial use and audience of the report; gathering the necessary material and evaluating it; the problem of deciding what material is to be included and the order in which it is to be presented; writing the report, including preparation of the final copy. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1957. 70 pp., $2.95.

Vorgespannter Beton

Following a brief review of fundamentals, the theory of prestressed concrete construction is considered in some detail, with examples of calculations. In the latter part of this book by A. Mehmel, the principles of the most important prestressing systems are outlined and illustrated. Published by Springer-Verlag, 1957. 131 pp., DM 17.40.

Van Nostrand's Scientific Encyclopedia
Third Edition

Considerably revised, this comprehensive reference work presents some 15,000 separate topics dealing with principles and applications of the physical sciences, medicine, and technology, including nuclear science and engineering. The presentation of each topic, beginning with a simple nontechnical definition and progressing to the more advanced phases, is helpful to the general reader. In addition to the customary cross references, all terms in the main alphabetical list are printed in heavy type wherever they occur. Published by D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, New Jersey, 1958. 1839 pp., $30.00.

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply photoprint or microfilm copies of any items in its collections. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

Engineering Societies Personnel Service

(Continued from page 122)

SALES LAYOUT ENGINEER for company manufacturing bakery equipment. Field work; make surveys of bakery making layouts, design floor plans, make recommendations for up-to-date equipment, etc. 3 months training period after which there will be traveling involved in the eastern and northern states. Headquarters, New York, N. Y. W5772.

TEACHING PERSONNEL in the fields of surveying, hydraulics, highway engineering and structures, principally the first two. Positions available in February or September, 1958. Location: Midwest. W5774.

HEAD OF CIVIL ENGINEERING DEPARTMENT, under 55, with M.S. or Ph.D. degree and 10 years' teaching experience, to take charge of department, teach structures and strength of materials. Position available in September, 1958. Salary, $7,000-$8,000 a year; possibility of summer employment. Location: New England. W5783.

SENIOR HYDRAULIC ENGINEER, civil graduate, with at least 2 years' hydrological and hydraulic experience covering engineering studies of dams, river flows, rainfall run-off, canals and water transportation. Must be citizen of U. S. Salary, $14,000 a year, plus extras. Location: Far East. F-5793.

ARCHITECT OR ARCHITECTURAL ENGINEER, experienced in estimating, design and project managing for a general contractor. Newly opened position. Salary commensurate with experience and ability. Company pays placement fee. Location: western Canada. W5804.

CONSTRUCTION SUPERINTENDENT, graduate civil, to take complete charge of the construction of a large industrial laboratory. Salary about $10,000 a year. Duration, 18 months. Location: Connecticut. W5812.

CONSTRUCTION SALES MANAGER, to 33, graduate, preferably from M.I.T. or similar school, with outstanding sales and management ability. Excellent opportunity with well established building contractor. Location: New York, N. Y. W5833.

PUBLIC HEALTH ENGINEER, graduate civil with sanitary option. 10 years' experience in environmental sanitation; will plan and direct, and supervise public health programs. Knowledge of Spanish. Salary, $12,000 a year, tax free. Some travel. Headquarters, Washington, D. C. W5845.

DESIGNERS, Bridge and Highway, with 3 years' experience in consultant's office. Apply by letter submitting complete resume. Location: Rhode Island. W5850.

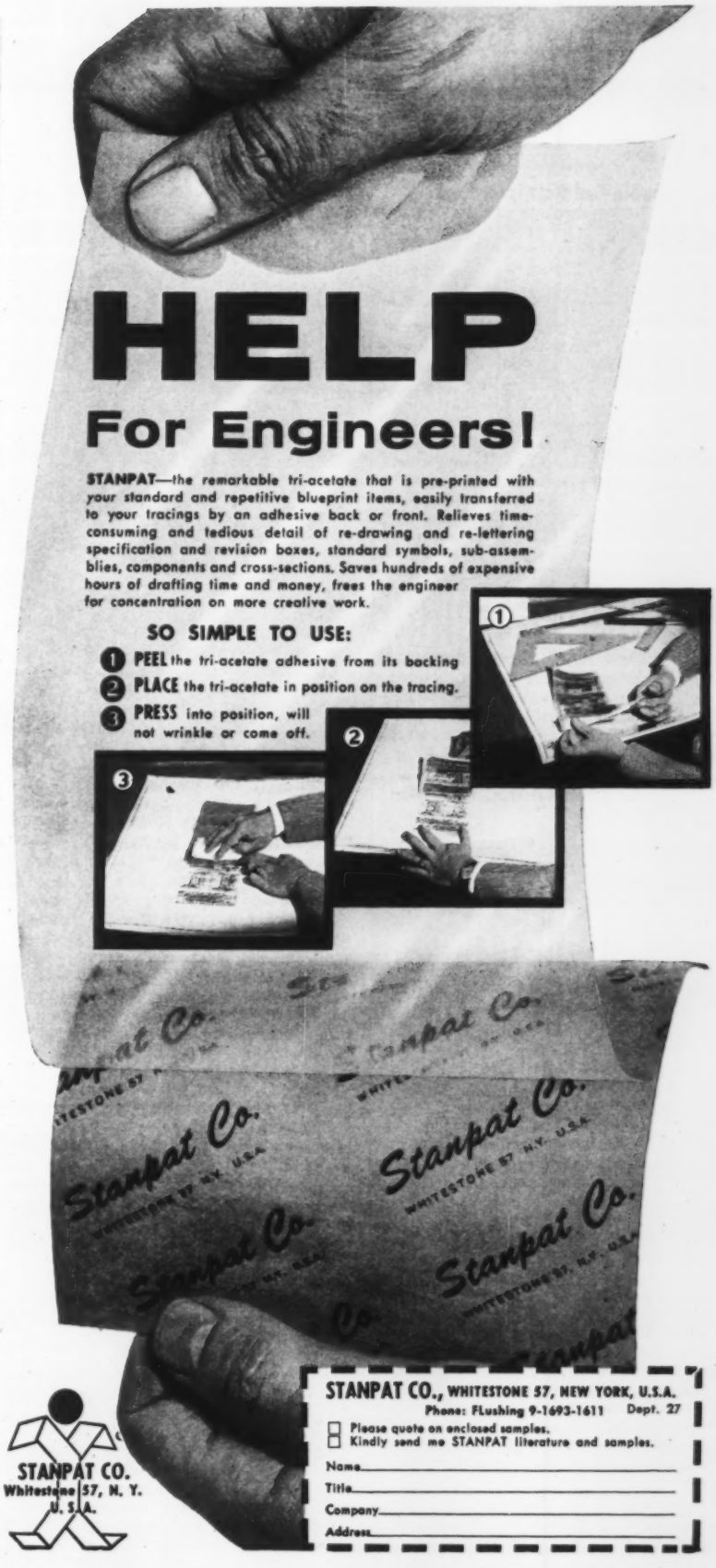
TECHNICAL WRITER, graduate electrical, with several years' experience in electronics, particularly guided missiles or radar. Must be citizen. Salary, $5,720-$7,280 a year. Location: New York, N. Y. W5870.

ENGINEER, graduate civil and structural, experienced. Will design complex steel structures, reinforced and prestressed concrete. Permanent. Company will pay moving expenses. Salary open. Location: Midwest. W5872.

MANAGER SALES AND MARKETING, Consulting Engineering Firm. Engineering and business administration experience. Minimum of 5 years' business planning, analysis, forecasting and programming with relation to potential, competition, share of market, timing and means of market development. Responsibility of appraising market. This is unique opportunity with consulting engineering firm in construction field. Salary, to $1,000 a month. Location: California. S-3330.

SENIOR CIVIL ENGINEER-WATER WORKS, B.S.C.E.; preferably hydraulic major; 30-45; with minimum of 5 years' experience in water development and conservation, to conduct studies of underground supply directed by consultant for employer. Salary open. Permanent opportunity. Location: San Francisco, East Bay. S-3345.

INSTRUCTOR, preferably teaching experience, several years' engineering experience, registered and advanced degrees, civil engineering graduate, engineering drawing, surveying, trap, mechanics, materials, soil mechanics, hydraulics and structures. Salary depends on experience and training. Location: California. S-3347.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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Double-Foil Batt Improved

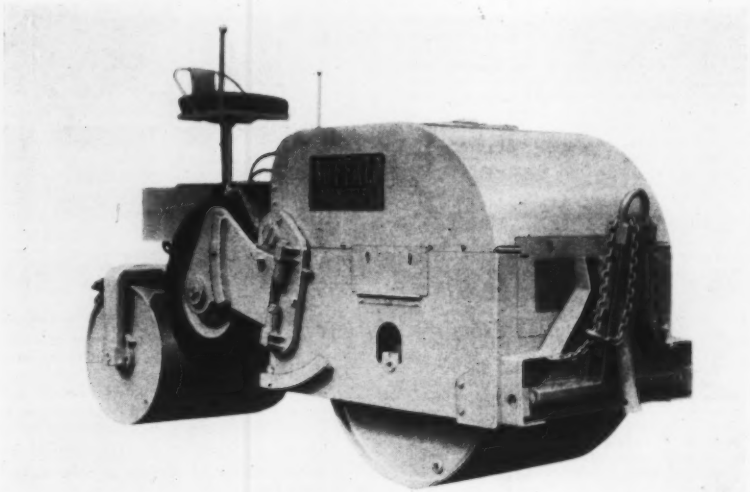
AN IMPROVED DOUBLE-FOIL batt designed for easier handling has been introduced to the rock wool building insulation line. Called "Reflecto-Batt," it has true foil on both the vapor barrier and breather surfaces, but plain kraft paper on the sides. The foil surfaces diminish the conductance of heat into the framing of a building, while the new product will handle better than the batt that had foil all the way around. When foil was used on the sides of the old type batt it had a tendency to crimp when compressed and would not allow the batt to spring back to its normal thickness without considerable fluffing. **Barrett Division, Allied Chemical & Dye Corp., CE-3, 40 Rector St., New York 6, N. Y.**

Dumpcrete Spreader

A NEW CONCRETE PAVING SPREADER has been introduced to the market. Named the Dumpcrete Spreader, it answers the need for equipment that can keep pace with the high production possible through central mixing and fast delivery with Dumpcrete hauling bodies. Job testing was completed this past season on a 7.2. mile, 4-lane divided section of the D. W. Winkelman Company's project for the Ohio Highway Department on Route 82 near Warren, Ohio. The spreader can take a 4½-cu yd load of concrete from a Dumpcrete body, spread a 20 to 26-ft wide slab, strike-off and be ready for the next load in less than 90 seconds. **Maxon Construction Co., Inc., CE-3, 2600 Far Hills Avenue, Dayton 19, Ohio.**

Electric Pencil Pointer

AN ELECTRICAL PENCIL pointer being offered to engineering and drafting departments is aimed at eliminating a source of drawing board mess, reducing pencil pointing time, and providing high quality points on engineering drawing pencils. Called "Point-O-Matic", the instrument contains, in a single package, a small synchronous motor which directly drives a fine sanding disk. The disk is permanently oriented to provide a very acute angle on drawing pencil leads. The pencil admittance hole contains a spring-loaded switch, which operates the motor when a pencil is inserted, and which turns the motor off when it is withdrawn. "Point-O-Matic" is designed to sharpen leads of either semi-automatic mechanical drawing pencils or leads of wooden pencils which have been first turned down in draftsman type pencil sharpeners. **Johnson Mfg. Co., Inc., CE-3, 117 Main St., Monroeville, Indiana.**



Portable Tandem Roller

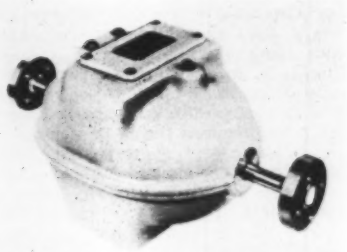
CALLED THE MODEL KT-8 Portable Tandem Roller, this machine features an entirely new concept in the retractability of towing wheels. When the wheels are not in use, they are raised hydraulically and folded into the sides of the main frame. This eliminates the usual overhang of transporting wheels, provides greatly increased operator visibility and holds the over-all operating width of the machine to an absolute minimum. Because of the fold away wheel feature, the roller can be worked adjacent to obstructions, high curbs and forms without removing the wheels. The design also permits the advantage of exceptionally high ground clearance. When it is to be transported, the wheels are folded out and hydraulically lowered into towing position. Hydraulic operation results in considerable savings in time and consequent costs when the roller is transported from one job site to another. Other features include unusually wide-faced bevel gears for lower gear tooth pressures and reduced wear. Adjustment for eliminating gear tooth backlash is incorporated through a unique shim arrangement. **Buffalo-Springfield Roller Co., CE-3, Springfield, Ohio.**

Steel Forms

A NEW IDEA IN STEEL form design now makes it possible to support over 300 tons of form and concrete high in the air without falsework. The load is carried on completed work. These special forms are now being used by Johnson-Kiewit, joint venturers on the $6 million substructure contract for the new bridge being constructed for the Berkshire Section of the New York State Thruway. Designed by Madigan-Hyland, consulting engineers, New York City, for the New York State Thruway Authority, the substructure consists of 42 pairs of circular concrete piers varying in diameter from 5-ft to 14½-ft. The pier bents are spaced 97-ft 6-in. apart with the exception of three central spans of 420-600-420-ft which cross the river. Each pier, excepting five short ones near each end, is tied with an intermediate concrete strut at the 60-ft level and a pier cap. Length of the strut and pier cap is 48-ft between 8-ft dia piers and 64-ft over-all. To form the columns, which range in height to 135-ft, the contractor is using 320 lineal ft of 8-ft dia column forms. They are fabricated in 5-ft lengths by 180-deg segments. Pouring 20-ft lifts the contractor has sufficient forms to keep four sets of 8-ft piers working all the time. There are 40 lineal ft of 14½-ft circular forms for river piers and 20-ft of 14-ft forms for anchor piers. **Blaw-Knox Co., CE-3, 300 Sixth Avenue, Pittsburgh 22, Pa.**

Magnetic Flow Meter

PREVIOUSLY LIMITED TO A minimum line size of 1-in., the Magnetic Flow Meter is now available for ½-in. flow lines. It will be particularly useful in ratio flow control systems where small flows are ratioed to larger ones. The smaller meter offers the full advantages of the larger instruments (1-in. and up); namely, over-all accuracy of 1% of full scale throughout the entire scale, no restriction of flow, linear flow readings, and performance unaffected by pressure, viscosity, density or changes in conductivity of the flowing liquid. The transmitter unit consists of a Teflon-insulated nonmagnetic flow tube containing flush-mounted metallic electrodes and surrounded by an a.c. electromagnet. When a conductive liquid passes through the tube, an alternating voltage is set up between the electrodes which varies linearly in proportion to the volume rate of flow. Lead wires from the electrodes transmit this voltage output to a Foxboro Dynalog Recorder, producing a chart record in appropriate units of flow. **The Foxboro Co., CE-3, Foxboro, Mass.**



Accuracy of 1%

Residual Chlorine Recorder

AN INSTRUMENT HAS NOW BEEN devised to fulfil the need of obtaining a continuous reading of the residual chlorine content of the water being treated with the object of ensuring that the applied dose should at all times meet the chlorine demands of the water. It is the Residual Chlorine Recorder of which two models are available, one giving a direct reading in parts per million and also a continuous chart record of the total residual chlorine in the treated water and the other model recording either the total or the free residual chlorine. In the latter model a reference cell is supplied with a continuous sample of the treated water from a small constant head tank. Neutral ortho-tolidine is applied in a mixing chamber to the portion of the water used for residual determination which is passed through a separate measuring cell and eventually to waste. Both cells are illuminated from a single light source by means of mirrors, the light passing through filters to individual photo-electric cells. The variations in colour induced by the interaction of the reagents with the chlorine in the sample cause the photo-electric cell to operate a differential electronic recorder. The reagents are passed to the mixing chamber by means of a multiple pump head consisting of a set of metering pumps driven by a small electric motor through a specially designed gear box. The latter also drives the pump which supplies the sample water to the mixing chamber, thus ensuring accurate proportioning of the reagents and water sample. **Paterson Engineering Co. Ltd. c/o F. & D. Brownlie, CE-3, 56 Grange Road, Ealing, London.**

Sump Pump

THE NEW DEVELOPMENT WITH the "Enpo" (Engineered Power) submersible sump pump is remote switch operation. A standard switch is mounted on the discharge pipe high above the pump itself and clear of the water area. This new position makes the switch easy to install, adjust to the desired cycle, and to service. All users of sump pumps will find the remote switch a handy marvel that relieves handling the instrument itself to service the switch. Its new position relieves straining to reach down to a switch on the pump to adjust it. Now, in arm's length, the switch can be adjusted for short or long cycling levels. In case of operating difficulty it is easily replaced with a new one from a jobber. Excellent as a cellar drainer, waste water disposal pump or bilge pump, the "Enpo" with remote switch is guaranteed for one year against defective workmanship or materials. **Piqua Machine & Mfg. Co., CE-3, Piqua, Ohio.**

Manganese Welded Dragline Chain

BECAUSE DRAGLINES TAKE TERRIFIC day-in and day-out pounding in earth moving, ore moving and surface mining operation, they have to be tough and long wearing. Up until now, cast manganese chain has been used because no successful method was evolved to commercially weld manganese steel, the metal which stands up best on draglines. Now, for the first time, a *welded* manganese steel dragline chain is being offered. The links of "McK-Manganese" dragline chain are formed and U-welded automatically to produce a chain of uniform strength; the balanced proportions of the individual links combine minimum dead weight with maximum load bearing capacity. Problems normally associated with casting blow holes or laminations are eliminated through the use of carefully selected manganese steel raw stock and rigid welding and inspection controls in manufacture. The chain is unique in several ways, for it is made from selected heats of nickel-modified austenitic manganese steels—the strongest of all chain material commercially available to industry, and it does not embrittle in work usage. **McKay Co., CE-3, McKay Building, Pittsburgh 22, Pa.**

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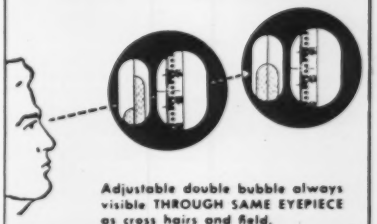

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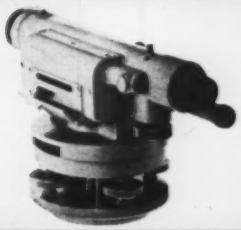

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Spreader

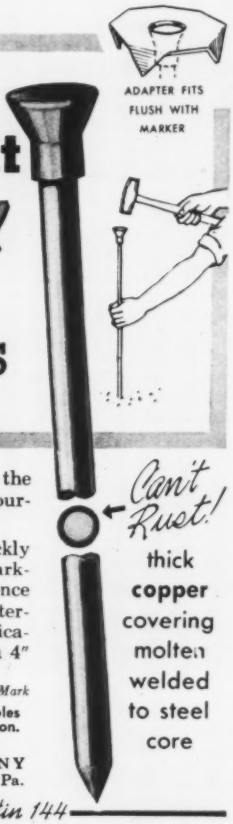
A NEW SPREADER FOR DUMP-TRUCK mounting has been developed. It is designed for sanding, cindering or salting for winter ice control work and for spreading stone, chips, calcium chloride and other materials to meet a wide variety of applications. Hardware for mounting is furnished with the new machine, and mounting or dismounting can be accomplished approximately in the same amount of time normally required for a tire change. The spreader is of twin-spinner design, and the spinner shafts may be adjusted to the most efficient length for any given dump truck body. They extend through sealed tubular housings and operate in oil. Bearings at both ends of the shafts and a specially designed housing casting eliminate any spinner shaft whip which might distort the spread pattern. Other features include one-man operation, from the cab; a wide spread area, which can cover a three-lane highway in a single pass; arrangements for spreading to one side without windrowing; even spread density; heavy-duty construction throughout; and chain-type conveyor with rugged cross-bars assuring long, trouble-free operation. **Shunk Mfg. Co., CE-3, Bucyrus, Ohio.**

One-Man Operation

One Coat Masonry Protective Products

SIKA-KOTE, A CEMENTITIOUS powder mixed with water, protects interior and exterior masonry walls above and below grade against water penetration and decorates with a single brush stroke. The product features twelve "Tropic-Glo" colors and pure Havana White and is packaged in one and four gallon containers and 50-lb sacks. One gallon (approximately 10-lb) covers 60-sq ft or more depending upon the porosity of the surface. Sika-Gard liquid floor hardener impregnates concrete surfaces to form a hard chemical compound that binds loose concrete particles, ending "dusting," increasing wear resistance, and reducing stains from oils and greases. It is simply spread over concrete floors with a long-handled broom or squeegee; one gallon covers approximately 250-350-sq ft. Floors may be walked upon or trucked over 24-hr after application. Deck paints, if later desired, may be applied directly over the Sika-Gard base with excellent results. Sika-Pel, a transparent water repellent impregnation for all masonry surfaces, sheds rain water and reduces efflorescence without discoloring even the lightest masonry surfaces. It may be applied with either brush or coarse nozzle, low-pressure spray. **Sika Chemical Corp., CE-3, 35 Gregory Ave., Passaic, New Jersey.**

Save with Permanent Copperweld TRADE MARK MARKERS



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Write for Bulletin 144

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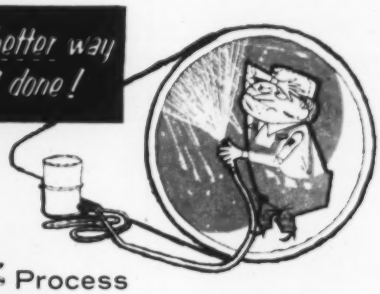

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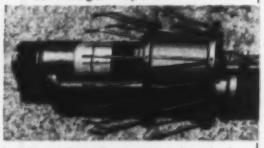

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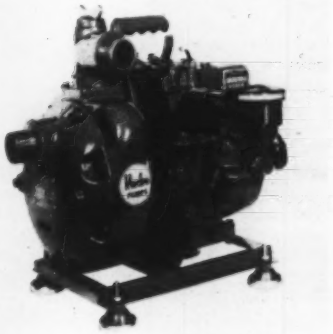
EQUIPMENT MATERIALS and METHODS

(continued)

Utility Pump

A NEW LINE OF SELF-PRIMING pumps for construction and utility service has been announced. Available in two sizes, the $1\frac{1}{2}$AA1 is powered by a 6BFB while the 2AA1 by a 8BFB recoil start Briggs & Stratton Engine. These pumps are designed to eliminate the need of a check valve. A self-lubricating long-life "Remite" mechanical shaft seal prevents leakage. A new type cover plate may be removed quickly for pump inspection. It



Maximum Flotation

has tapped holes for both vacuum and pressure gages as well as a "drain" plug. Discharge outlet can be quickly changed to any one of three positions. A thumbscrew filler-plug, in the top of the pump, makes possible rapid filling of the case. The base of the unit was designed to afford maximum flotation for the pump in soft or muddy ground. When used on a hard-road surface, rubber shock-mount feet may be added in a matter of seconds. **Marlow Pumps, Div. of Bell & Gossett, CE-3, Midland Park, N. J.**

Stainless Steel Cube Mold

A SPECIAL STAINLESS STEEL cube mold which will help cement manufacturers make stronger, longer lasting materials for use in construction and highway building has been introduced on the market. Made By Bowen & Co., Inc., of Bethesda, Md., it is manufactured to close tolerances of a plus or minus .001. Supplied by Allegheny Ludlum Steel Corp., the stainless steel was specified primarily for its corrosion resistant quality. Cement is mixed and cast into the molds to make 2-in. cubes, which, when hard, are tested for strength, density and other characteristics. Cement makers keep a constant quality watch on their material, and one of the principal checks is made in these stainless steel cube molds. **Allegheny Ludlum Steel Corp., CE-3, Pittsburgh 22, Pa.**

Put this versatile DGH-100 Hammer to work on any job you have ★ you'll be amazed at the number of jobs it can handle ★ operates on compressed air or steam ★ delivers a rated striking energy of 386 pounds ★ just over 4 feet long it is readily moved about in a jeep. Illustrated here is the DGH-100 Hammer being used with a LeRoi Tract-Air breaking concrete curbing.

Manufacturers of Pile Driving Hammers and Piling Extractors Since 1852

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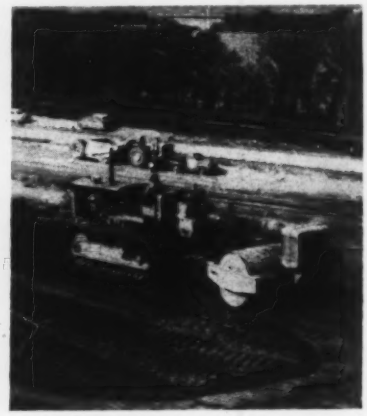
EQUIPMENT, MATERIALS and METHODS

(continued)

Vibratory Roller

NAMED THE BROS VIBRA-FACTOR, this new machine features a static (gross) weight of 4½-tons and a controlled variable vibratory force equal to a range from 7½-tons to 10½-tons. Vibratory frequency range is 1100 to 1300 vibrations per min. Of special importance is the quarter inch amplitude—the distance the drum is raised from the ground each revolution. This "thumping" or impact



Quarter Inch Amplitude

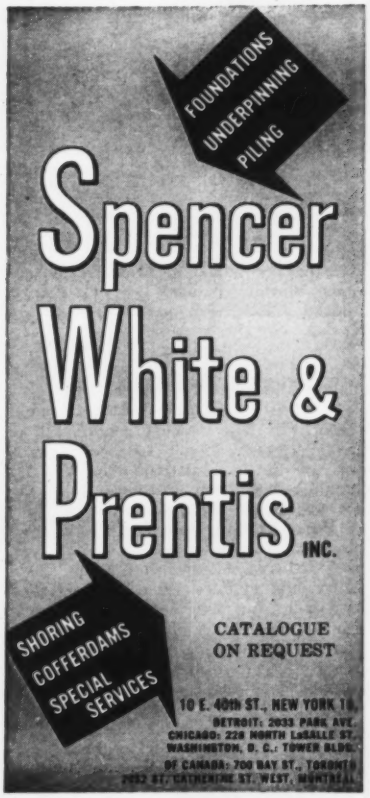
force combined with the drum weight helps achieve densities in excess of standard AASHO requirements in heavy cohesive subgrade and embankment materials. Unique bearing mountings in the drum isolate the bearings from the vibratory forces; the frame, too, is protected from vibration by special rubber mountings. **Bros. Inc., Road Machinery Div., CE-3, 1057 Tenth Ave., Minneapolis 14, Minn.**

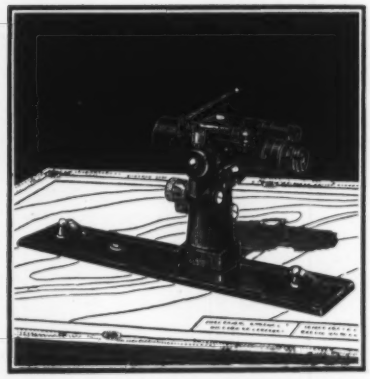
Machine Construction Kit

A UNIQUE MACHINE CONSTRUCTION kit designed to enable engineers, designers, scientists, inventors and automation specialists to make precision working models of practically any type of machine, drive or mechanism is now available. It uses a basic construction concept of round rods and beams that are assembled into frameworks by rugged clamping means and a wide variety of precision-machined mechanical components such as ball bearings, spur, bevel and internal and worm gears. It is possible to construct smooth-operating, precision-detailed mechanisms such as reciprocating motions, slide motions, geared transmissions, differentials and coil-spring devices with standard kit components. In addition to permitting the development of new ideas and creation of machines and mechanisms in design work, models made with the kit can be used to prove and sell mechanical concepts and serve as sales tools. **FAC Division, CE-3, 9551 Grand River Avenue, Detroit 4, Michigan.**

Corrosion-Resistant Pipe

AT THE 26TH EXPOSITION of the Chemical Industries in New York City, Lukens Steel Co. unveiled a highly corrosion-resistant pipe whose inside surface is a layer of solid stainless steel, completely and permanently bonded to a heavier outer layer of carbon steel. Clad pipe can now be fabricated and joined while still preserving the integrity of the vital inner layer of stainless. In addition to the chemical industry, where the new pipe will be a cost-cutter in handling such corrosive materials as nitric acid, clad pipe is expected to be of great importance to the petroleum, petrochemical, and nuclear industries. **Lukens Steel Co., CE-3, 1957 Lukens Bldg., Coatsville, Pa.**





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EQUIPMENT MATERIALS and METHODS

(continued)

Cab-Forward Truck

DEVELOPMENT OF A VERSATILE new cab-forward type truck, featuring several engineering advances, has been announced. Adaptable both for light and heavy hauling in the city or over the road, it will be produced for use either as four or six wheel trucks or tractors, and will be available with either gasoline or diesel engines. The new vehicle will be the first cab-forward type with set-back front axle capable of accommodating a diesel engine over 200-hp. It also features a wrap-around windshield of unusual size, permitting an exceptionally wide and deep angle of vision. The driver has maximum vision ahead, to the sides and up and down. Extra-wide doors permitting quick, easy entry and exit, enclose the steps, protecting them from snow and ice accumulations during winter driving. For driver safety in city delivery work, entry and exit is easily accomplished through the right as well as the left door. **Mack Trucks, Inc., CE-3, 1355 West Front Street, Plainfield, New Jersey.**

Maximum Vision

New Line of Hooks

A NEW LINE OF HOOKS in sizes from ¾-ton through 150-ton capacities is now available. It offers higher capacity per size than any hook now on the market and in addition, each hook is unconditionally guaranteed against breakage. The rated capacities are stamped permanently on the hook, to permit easier selection of a hook for a given job. Also this feature will help eliminate the danger of overloads due to carelessness. The hooks are forged in three materials to give the variation in capacities—C-1030 forging steel, heat treated, provides capacities from ¾-ton through 100-ton. **Crosby-Laughlin Div., American Hoist & Derrick Co., CE-3, P. O. Box 570, Fort Wayne, Indiana.**

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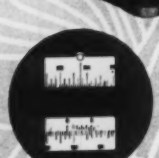

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30-Ton Concrete Beams

THE INGENIOUS APPLICATION OF Multiton Roller Skids made it easier for Humphreys & Harding, building overpasses for the new superhighway outside Washington, D. C., to pour post-tensioned concrete beams at the job site, and move them quickly and simply into place for construction. The 30-ton reinforced beams, some as long as 100-ft, had to be moved approximately 100-yd along residential streets, from the pouring molds to the overpass site. Use of cranes to move the beams proved impractical, because of the danger of damage when the long beams swung around on the crane cables, and because the cranes could be used more efficiently at the construction site itself. To solve this problem, the beams were mounted on wood blocks, and then two Multiton Roller Skids were placed under the blocks, at each end of the beam. **Stokvis-Edera & Co., CE-3, 18 Secatoag Ave., Port Washington, N. Y.**

Tractor-Loader

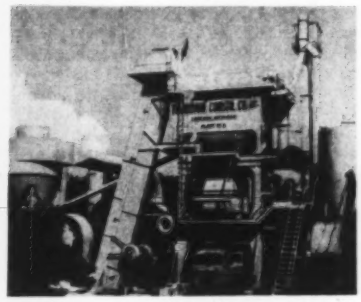
A NEW 4-WHEEL DRIVE, rear-wheel-steer tractor-loader, which is said to incorporate revolutionary advancements in operating and safety features, in the 1¾-cu yd class, has been announced. Called the W-9 Terraload'r, it is the fore-runner of a completely new series of heavy duty rubber tired industrial loaders to be introduced by Case in the

W-9

near future. Three interchangeable buckets are available—1⅜-cu yd (heaped) heavy duty digging bucket; 1¾-cu yd standard material bucket; and 2¾-cu yd light material bucket. An outstanding new design feature is the use of short, rigid lift arms, pivoted forward of the operator's position. This, together with a low center of gravity and extra-wide wheel tread (74¾-in.), are said to give the W-9 exceptional side-stability, as well as longer forward-reach in all positions. Location of the lift-arm-pivot, and elimination of all linkage in back of the bucket, are also said to offer important safety advantages, since the operator has unobstructed visibility in all directions, and can easily get on or off the machine, regardless of whether the boom is up or down. In addition, there is no danger of the operator's arm being caught in the lifting mechanism. **J. I. Case Co., CE-3, Racine, Wis.**

Batch Capacity Asphalt Plant

BIGNESS THROUGHOUT, COMPLETE PORTABILITY and fast automatic operation are key characteristics of the new Madsen Model 481 6000-lb batch capacity asphalt plant recently set up at St. Ignace, Michigan for mixing bituminous concrete for the surfacing of the approaches and Michigan's new Mackinac Bridge. Thornton Construction Co., Inc. of Hancock, Michigan, owners of this plant, handled this important phase of work. Capable of turning out considerably more than 200-T.P.H. the plant was literally "loafing" on this particular job be-



Completely Portable

cause of the conditions under which the contractor had to operate. On the approaches alone there was a total of 90 joints, 37 on the north approach and 53 on the south. The considerable amount of work entailed on each of the joints held production to a minimum. Designed to handle today's fast moving asphalt paving jobs, the plant is completely portable. Transport wheel equipment is furnished for the screen bin section, mixer weigh-box section, hot stone elevator and dryer. Dust collector and washer may also be wheel equipped. **Madsen Iron Works, Inc., CE-3, E. Rosecrans & Valley View, La Mirada, Calif.**

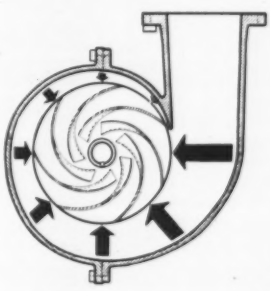
Movable Shoring Box

USE OF A MOVABLE shoring box in the excavated trench for a new reinforced concrete pipe sewer line in Springfield, Ohio, saved contractor Said Haddad days of construction time and afforded increased worker safety. The box, made of ⅜-in. sheet steel, framed by 3-in. and 6-in. dia steel pipe, was 20-ft long, 14-ft wide, and 16-ft deep. The sides were unbroken and protected workers in the trench against cave-ins and slides as they set in place and joined the 8-ft sections of concrete pipe. The front was closed in by planking half way down as protection against cave-ins and spill from the newly excavated earth in the direction of laying and the back was open to permit back-filling as the work progressed forward. Contractor Haddad used a Marion Shovel to scoop the trench down nearly to grade, working only about 20-ft ahead of the pipe laying, then dragged the movable shoring box ahead on runners at the bottom of the excavation. A clam shell on a Lorain Thew crane then was used to bring the pipe trench down to final grade, the average depth of the line being 20-ft.

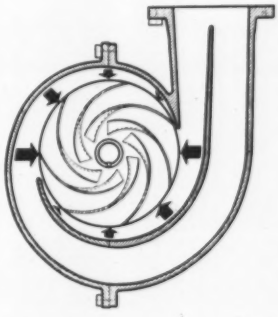
Wire Reinforcement Institute Inc., CE-3, National Press Bldg., Washington 4, D. C.

Boron Increases The Life Of Tractor Sprockets

AN INNOVATION IN MODERN metallurgy promises good news to owners of earth-moving equipment. Setting an industry precedent, the element boron is being used to measurably increase the life of crawler tractor sprockets. Marketed under the trade name Boralloy, these sprockets are now standard equipment on Caterpillar D8 and D9 Tractors. Representing the first commercially successful attempt to produce boron-bearing cast carbon steel by the acid open hearth process, it was developed as a cooperative research project between Caterpillar Tractor Co. and Harrison Steel Castings Co. Boron, an unglamorous element until recently, is now widely acclaimed as a worker of miracles. Its compounds are finding literally hundreds of uses. It is opening brand new concepts in the fields of automotive fuels, jet and rocket fuels, plastics, and pharmaceuticals. The first applications in which Caterpillar used boron steels included large diameter studs and bolts and certain relatively new low-alloy steels. **Caterpillar Tractor Co., CE-3, Peoria, Illinois.**



Drawing showing unbalanced pressures acting on impeller and shaft in single volute pump whenever it is operating at below peak efficiency.



Drawing showing how radial forces are equalized in Wheeler-Economy Dual Volute Centrifugal Pumps. Note that the inlet for each volute is 180° from the other.

How Wheeler-Economy

Dual Volute Design

prolongs pump life by equalizing radial forces acting on pump impeller and shaft

Operating high-head, high-capacity centrifugal pumps at less than peak efficiency—even intermittently—can cause considerable trouble. Forces of five to ten times the weight of the rotating parts are set up, often with the result that the pump shaft breaks, the casing rings wear prematurely and the stuffing box leaks.

Wheeler-Economy Dual Volute design solves these problems by forcing the liquid to accelerate and decelerate at a uniform rate regardless of load. As you can see from the sketch, liquid leaving the impeller at the "nine o'clock" position enters one volute; liquid leaving at "three o'clock" enters the other. In this way, radial pressures at each point along the impeller periphery are balanced by equal and diametrically opposite pressures—eliminating eccentric wear of stationary parts and pump shaft fatigue failure.

Fill out and mail the coupon below for complete information on Wheeler-Economy Dual Volute Centrifugal Pumps. Or see your representative.

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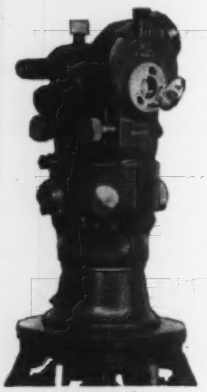

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EQUIPMENT, MATERIALS and METHODS

(continued)

Steam Cleaner

A LINE OF STEAM CLEANERS for road building equipment, which is suitable for use under all kinds of conditions, has been produced. There are the heavy duty materials, used for removing large deposits of grease, oil and road dirts. The medium duty materials are recommended where the deposits are average and where heavy duty cleaners are not necessary or desired. The light duty materials are for removing small deposits without damaging the paint beneath. These steam cleaners are also formulated to combat varying water conditions. In hard water areas, for example, a tenacious, cloudy film is left on the surfaces when soap type steam cleaning compounds are used. **Magnus Chemical Co., Inc., CE-3, South Avenue, Garwood, New Jersey.**

Tractor Shovel

THE MODEL 404 TRACTOR shovel is the newest addition to the Trojan line of 4-wheel drive pneumatic tire loaders. It weighs 40,500-lb, has an operating capacity of 14,000-lb and is designed to handle all types of bulk materials. This multipurpose tool has loaded sand, gravel and crushed stone directly into the sideboard railroad cars (battleships) as well as into trucks. It has proved itself in quarry operations by quickly and efficiently loading shot rock. In coal stripping operations it has handled the stripping of the overburden and excavated and loaded the coal. **The Yale & Towne Mfg. Co., CE-3, Chrysler Bldg., New York 17, N. Y.**

Weighs 40,500-lb

Shoring System Cuts Erection And Dismantling Time

A NEW SYSTEM OF SHORING which sharply reduces cost, so simply engineered that it can be erected in 40% less time than standard shoring, and so flexible that its towers can be built in 1-ft steps for all heavy duty concrete shoring purposes on municipal projects, including buildings, bridge foundations, reservoirs, sewage disposal plants and highway construction, has been announced. Using no nuts, bolts, or X-bracing, its basic parts are a heavy duty tubular steel frame, a ledger carrier and an adjustable screw jack. An exclusive "slip-fit" design whereby the leg members of one frame slip easily into the notched sleeves of another makes it possible for one man to assemble and raise a 5-ft square tower to shoring level in a matter of minutes. **Brainard Steel Div., Sharon Steel Corp., CE-3, 2000 Griswold St., Warren, Ohio.**

Fowler Loader

THE FOWLER LOADER IS A boom-type attachment for lift trucks. The boom is adjustable in length from 14 to 17-ft, extends horizontally in front of the forks, and swivels so that it can swing three to four feet either side of center. At the outer end of the boom is a 360-deg swiveling plate for the attachment of two ⅜-in. dia steel cables upon which the load is slung. Provision is made for quick attachment and adjustment of these slings. The complete loader weighs about 1500-lb. It can be attached to a lift truck in less than five minutes. The truck simply drives up to the loader, which is "parked" with the boom horizontal (supported near the outer end on a sawhorse or stand), and slips its forks into the channels provided in the loader base. A hook or bolts, depending on the type of truck, are tightened to brace the boom to the mast. There are no hydraulic or electric motors or controls—nothing to go wrong. To raise the load, the operator simply raises the forks. **Signode Steel Strapping Co., CE-3, 2600 North Western Ave., Chicago 47, Ill.**

Portable Hydraulic Motor Pump

A SMALL, FAST, POWERFUL, portable hydraulic motor pump developing up to 10,000-p.s.i. pressure and weighing only 65-lb, has been announced. Besides being used with any make of hydraulic benders, pipe pushers, knock-out punches or hydraulic jacks, it can readily be installed and adapted to give fast continuous power to existing equipment. The pump is rated for 10,000-p.s.i. intermittent and 5,000-p.s.i. continued duty delivering 80-cu in. of oil per minute and is driven by a standard ½-hp single phase, 60 cycle, 1,750-R.P.M. 110-220 volt motor. **Tal Bending Equipment, Inc., CE-3, Milwaukee 2, Wis.**

EQUIPMENT, MATERIALS and METHODS

(continued)

Concrete Saw

A NEW CONCRETE SAW, the Model C-180, featuring a 23% increase in power, uses an 18-hp Wisconsin engine, with a more powerful transmission, which delivers greater torque to the drive wheels. The increased horsepower means faster sawing, longer blade life, and greater engine life, and has been achieved with no sacrifice in maneuverability. The saw not only has the power for sawing control joints but has the maneuverability and ease of operation that is so essential for plant maintenance work. In addition to a higher horsepower engine, and a more powerful transmission, the C-180 features a clutch type water pump, which eliminates the necessity of disconnecting the water pump belt when running the saw dry, or when idling for extended periods. The exclusive 3 Point No-Bind Blade Suspension, with four wheels and pivoting front axle keeps the blade straight and true in the cut, even on rough, irregular surfaces. This prevents binding, twisting, or drifting in the cut. You can line-up and saw in seconds. **Clipper Mfg. Co., CE-3, 2800 Warwick, Kansas City 8, Mo.**

Increased Horsepower

Roller-Compactor

DEEP PENETRATION VIBRATORY COMPACTION and static-weight surface rolling can be accomplished in a single operation by a new road-building machine, the Roller-Compactor. When not needed as a vibratory compactor, the machine serves as a regular three-wheel, 10 to 12-ton variable weight roller. The vibratory portion of the present machine is a self-contained unit which can be used only with Austin-Western Model 102 10 to 12-ton variable weight rollers. The unit consists of a three-shoe vibrator assembly, an independent hydraulic system and a separate 61-hp gasoline engine. Compaction is accomplished by two steel shoes 27-⅞-in. wide and 25-¼-in. long, and a center shoe 25-½-in. wide by 25-¼-in. long, actuated by hydraulic pump-gears which operate in unison to produce a straight line vibration across the full 82-¾-in. length of the vibrator. Each shoe weighs 450-lb and vibrates through a vertical distance of ¼-in. at the rate of 2100 to 2200 times a minute. The shoe assembly is lowered to working position, or raised when the unit is not in use, by a valve and lift cylinder powered by the hydraulic steering circuit of the roller. **Austin-Western Div., Baldwin-Lima-Hamilton Corp., CE-3, Aurora, Ill.**

Track Press

A COMPLETELY NEW TRACK press that cuts crawler-track overhaul time in half —with complete safety for operator and bystanders—has been developed. Not only can it push both pin and bushing simultaneously without broaching or damaging sidelinks, but tests show one man alone can take down and reassemble even badly rusted track in just half the time required using other presses—without damaging pins, bushings or sidelinks. **Owatonna Tool Co., CE-3, 612 Cedar St., Owatonna, Minn.**

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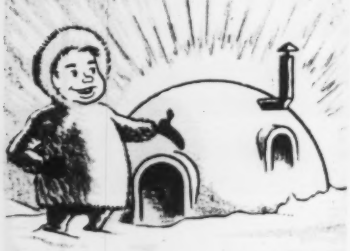

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Literature Available

PAVER-FINISHER—A new 12-page bulletin describing the PF-90 Bituminous Paver-Finisher is now available. The two-color brochure illustrates many of the various application possibilities of the paver-finisher. General specifications are also provided on the hopper, screed, travel, traction transmission, conveyor-auger control transmission, master clutch, front wheels, and tandem drive. **Construction Equipment Division, Blaw-Knox Co., CE-3, Mattoon, Illinois.**

FASTITE JOINT PIPE—According to this new brochure, Fastite Joint pipe is the result of over 10-years research and testing on slip-type single gasket joints, and embodies design features of significant advancement. The bell is scientifically designed with two gasket recesses and a buttress, manufactured to close tolerances, so that the gasket is self-centered, securely confined and firmly compressed for permanent, tight, trouble-free service. Distinct photographs of typical installations, step by step assembly, and specifications are also included in this pamphlet. **American Cast Iron Pipe Co., CE-3, Birmingham 2, Ala.**

EVAPORATORS—The three types of evaporators discussed in this recently published booklet are low pressure steam, heat recovery and vapor compression. Developed primarily for marine use, they are unusually compact in design and well suited to installations where space is at a premium. Included in the pamphlet are diagrams showing the hook-up of the three distillation units. **The Maxim Silencer Co., CE-3, 85 Homestead Ave., Hartford, Conn.**

BATCHING PLANTS—This booklet shows illustrations of batching plants for every purpose—road builders, pipe plants, prestressed concrete plants, and project builders. The plants consist primarily of four pieces of equipment—aggregate bins, which are of all-welded construction, freely reinforced at all points of stress; batchers, equipped with beam scale with "over-under" indicator or dial scale; cement silos, both ground and elevated types are one-piece units of all-welded construction; and cement elevators, of which two sizes are available. **L. O. Gregory Engineering, CE-3, 2697 Barron Ave., Memphis, Tenn.**

METAL GRATING HANDBOOK—This handbook has been prepared by the Metal Grating Institute, a non-profit organization of firms manufacturing metal gratings and treads. In addition to test data, standard design procedures, specifications, and uses for gratings, it includes a code of standard practices in general use by the major portion of the metal grating producers and a glossary of terms. It is priced at $1.00 a copy. **Metal Grating Institute, CE-3, Suite 759, One Gateway Center, Pittsburgh 22, Pa.**

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PRESTRESSED CONCRETE—This 14-page brochure briefly covers history and development of prestressed concrete and explains the Prescon System of post-tensioning. It includes application examples in numerous different types of structures, detailed technical data, estimated labor for placing, guide specifications and detail drawings. **The Prescon Corp., CE-3, P. O. Box 4186, Corpus Christi, Texas.**

PHOTOGRAMMETRIC EQUIPMENT—A few of the instruments discussed in this pamphlet are precision cameras, the Model R56 rectifier, the aerial film viewer, and the junior copy camera. It states that the precision cameras are converted with an entirely new focal plane frame with precision fiducial marks that are not disturbed when magazine is removed. The model R56 rectifier can also double as a photo enlarger and a transforming printer. Magnification range is 0.5 to 5.0 dia with direct ratio scale. It is motor driven with hand wheel for fine setting. Included also in the booklet are large, distinct pictures and specifications. **Kargl Co., Inc., CE-3, Box 6647, San Antonio, Texas.**

ELASTUF PENN—According to a newly published booklet, Elastuf Penn machinery steel is a 45% carbon special analysis steel that was developed to satisfy industry's need for a free machining medium carbon steel with superior mechanical properties. It cuts freely, without tearing, on all operations of turning, milling, threading, boring and reaming. Due to very special processing procedures, warping in machinery of shafts is minimized. **Horace T. Potts Co., CE-3, Erie Ave. & D Street, Philadelphia 34, Pa.**

WINTER CONCRETING—Reprinted in a handy 8-page brochure, are the recommended practices for winter concreting adopted by the American Concrete Institute. Because the concreting methods used during cold weather must prevent damage to concrete from freezing and thawing at an early age, allow the concrete to develop early strength, maintain proper curing conditions, and limit excessive or rapid temperature changes, the ACI Committee suggests air-entrained concrete and addition of one per cent of calcium chloride by weight of cement in cold weather. Of particular interest are the eight charts which show the comparative compressive strength of concrete made with Type 1 and Type 3 cements with zero and two per cent calcium chloride by weight of cement. Temperature comparisons are made at 25, 40, 55, and 73 F. **Calcium Chloride Institute, CE-3, 909 Ring Building, Washington 6, D. C.**

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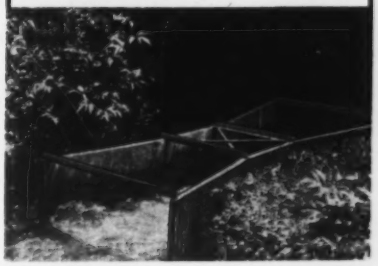

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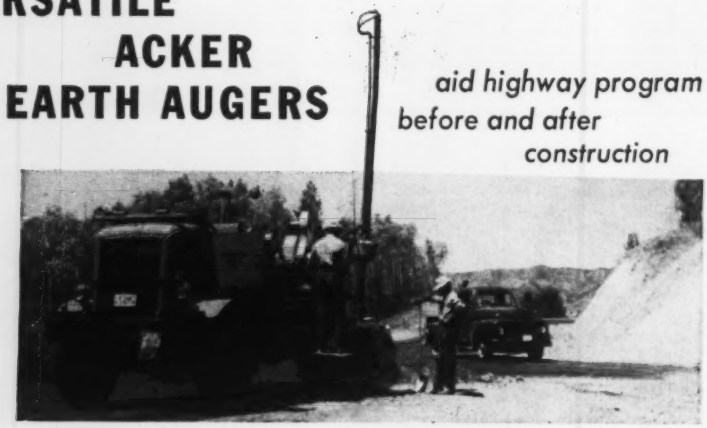

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Films Available

HYDRAULIC BACKHOE—A new 16mm sound and color motion picture on the Hyster D4 Hydraulic Backhoe is now available for viewing. This film explains and illustrates the exclusive design and performance features of the backhoe that make it the ideal utility excavating machine for solving the multitude of digging problems encountered by contractors, gas companies, and public works departments. **Hyster Company, CE-3, 2902 N. E. Clackamas Street, Portland 8, Oregon.**

"THE PRECO AUTOMATIC BLADE CONTROL"—In order to show how finish grading can be done faster, easier and with greater economy, a 16mm, five-minute film has been produced. Photographed under actual job conditions, the movie demonstrates the advantages of the control. The motor grader operator begins the demonstration by setting the calibrated dial for desired moldboard adjustment. As soon as the grader begins a pass, the control takes over and maintains the preselected slope across the grade. **Caterpillar Tractor Co., CE-3, Peoria, Ill.**

"HIGHWAY HEARING"—A motion picture aimed at creating public understanding of the $51-billion Federal Interstate Highway program has been released. The film was developed in cooperation with highway authorities at the national, state and local levels. It is designed to help the public understand the aims and benefits of the nation-wide program. **The Dow Chemical Co., CE-3, Midland, Michigan.**

"THREE LEGGED ISLANDS"—This new 18-min color movie shows construction and operation of offshore platforms. The two platforms discussed in the film are the "Scorpion," which recently set a time record for relocation activity in the Gulf of Mexico, and the "Vinegarroon" which weathered hurricane Audrey with virtually no damage. **R. G. LeTourneau, Inc., CE-3, 2399 South MacArthur, Longview, Texas.**

"SUCCESS STORY"—Los Angeles TV viewers were treated to a short course in asphalt plant operation, black top production and asphalt highway building recently. From raw material in storage at the plant site to the Standard Steel 4000-lb asphalt plant and then to the actual laying of hot asphalt mix on a strip of cleared land—close-ups and panoramic views were screened with four cameras in constant use. Kinescopes of the half-hour show are available on loan. **Industrial Asphalt, CE-3, 1100 South Beverly Drive, Los Angeles 35, Calif., and from Standard Steel Corp., CE-3, 5001 S. Boyle Ave., Los Angeles 58, Calif.**

TIDE GATES

Fig. B-68, Type M
(CIRCULAR)

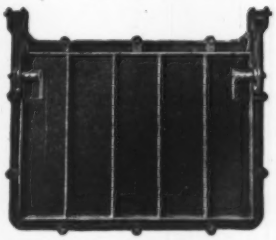

Fig. B-61, Type MM
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From the MANUFACTURERS

TRAINING SCHOOL: A new sales-service training school has been announced by the Schield Bantam Co., Waverly, Iowa, world's largest producer of truck-cranes and excavators. Included in the school's program will be such fields as engineering and design features, product application, markets, selling aids and tools, and analysis of competitive equipment . . . **NEW DIVISION:** The C. N. Flagg & Co., Inc., Meriden, Conn., has established a new division. A training and experimental department has been set up to train selected personnel in the special techniques necessary in the fitting, welding, and inspection of nuclear piping, where perfect workmanship is so vital . . . **CELEBRATES ANNIVERSARY:** Barco Mfg. Co., Barrington, Ill., will celebrate the 50th anniversary of its founding. This 50 years represents growth from a small 4-man second-story factory in Chicago, making a few brass products, to a 103,000-sq ft modern factory with a wide range of products of their own invention and design, serving practically all industry . . . **NEW COMPANY:** A group of experienced painting contractors, paint chemists and application technicians have organized to form the Corrosion Protection Services Co., Inc., with offices in New York City. The prime purpose of the organization is to provide qualified personnel experienced in the technical aspects of the application of the heavy duty coatings so frequently mishandled by the architectural painting contractor . . . **OPERATORS SCHOOL:** The Western National School of Heavy Equipment Operation, Inc. at Weiser, Idaho, offers four classes covering a period of six to eight weeks. In addition to the course on preventive maintenance and operation of the Austin-Western Super 99, manufactured by the Austin-Western Div., Aurora, Ill., there is a course on the general maintenance and overhaul of diesel engines and a course designed to train men in protective maintenance and correct operation of the crawler-tractor and self-propelled rubber-tired scraper . . . **EXPANDS PLANT:** To keep pace with growing markets and to provide for prompt delivery for its customers, Roots-Connersville Blower Div., of Dresser Industries, Inc., has just completed a major expansion of its main plant. The new department will be devoted to the production of type AF Rotary Positive Blowers and type XA Rotary Positive Gas Pumps . . . **APPOINTMENTS:** Walter Ellingboe has been elected representative for the Milwaukee Valve Co. covering Wisconsin, Northern Michigan and Eastern Iowa . . . Harold E. Boncutter has been made advertising manager of Galion Products, Inc., Galion, Ohio . . . The Union Metal Mfg. Co., Canton, Ohio, has announced the election of Mr. C. A. Streb as chairman of the board.

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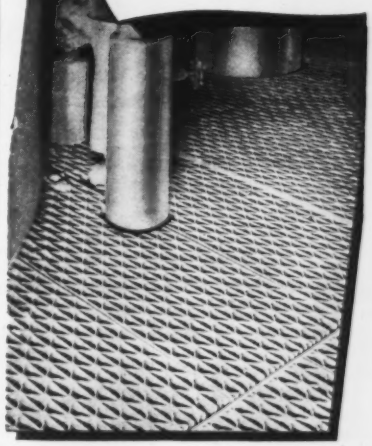

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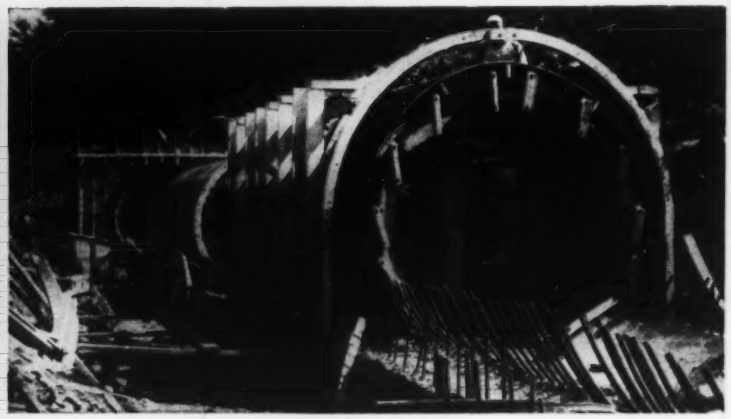

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February

1528. Turbulence Characteristics of the Hydraulic Jump, by Hunter Rouse, T. T. Siao, and S. Nagaratnam. (HY) Hot-wire measurements of turbulence in an air-flow model of the hydraulic jump are described for Froude numbers of 2, 4, and 6. Results are analyzed and interpreted in the light of momentum and energy integrals.

1529. The Haas Hydroelectric Power Project, by J. Barry Cooke. (PO) Engineering considerations, design criteria, and construction data for a high head hydroelectric project are presented. The features of this project are an underground power house, a 290-ft-high rockfill dam, an unlined pressure tunnel, and multiple-jet, vertical-shaft impulse turbines.

1530. The Total Sediment Load of Streams, by Emmett M. Laursen. (HY) Relationships are proposed that give the quantity and quality of the total, suspended, and bed loads as functions of the stream and sediment characteristics. In the process of empirically defining the relationships, a correlation of laboratory and field data was obtained.

1531. Sediment Transport in Money Creek, by J. B. Stall, N. L. Rupani, and P. K. Kandaswamy. (HY) A hydraulic study was made of Money Creek and sediment capacity determined by the Einstein, Schoklitsch and DuBoys formula. Utilizing flow duration information, the total quantity of bed material moved is calculated. Actual bed material size sediment is compared with the sediment transport.

1532. Field Investigations of Spillways and Outlet Works, by Benson Guyton. (HY) Included in the Corps of Engineers hydraulic field testing program are flood-control and multiple-purpose projects, river and harbor works, and estuarine and wave problems. Test data examined include spillway, conduit-intake, and gate-leaf pressures; air demand, and concrete friction factors.

1533. Media Characteristics in Water Filtration, by Gaurchandra Ghosh. (SA) A study has been made on the effect of media characteristics in water filtration. Data are presented which show that the current ideas regarding turbidity penetration and removal of turbidity in the top layers of the filter are misconceptions.

1534. Sewage Disposal in Santa Monica Bay, California, by C. G. Gunnerson. (SA) The results of receiving water studies made in connection with the expansion of Los Angeles' Hyperion Treatment are reviewed and analyzed in terms of the degree of treatment required for effluent discharged five miles offshore.

1535. Model Study of a Dynamically Loaded Pile, by Roy D. Gaul. (SM) Tests made on a model of a vertical pile in soft soil indicate that a low frequency oscillatory lateral load induces pile bending moments that correspond to moments caused by the same load applied statically. Computation of pile moments appears to agree with dynamic test results.

1536. Dewatering Excavation, Low Sill Structure, Old River, La., by C. I. Mansur and R. I. Kaufman. (SM) This paper presents the results of pumping tests performed to determine the adequacy of a system of deep wells installed to lower the piezometric head in a deep stratum of pervious sand underlying the excavation for the structure.

1537. A Method to Describe Soil Temperature Variation, by E. B. Penrod, W. W. Walton, and D. V. Terrell. (SM) Values for thermal diffusitivity, temperature, and temperature amplitude were determined from observed data. These constants were used in an equation to describe the variation of temperature with time at any soil depth. Calculated temperatures and mean observed soil and air temperatures are plotted for comparison.

1538. Discussion of Proceedings Paper 1216, 1285, 1350. (PO) S. Logan Kerr, R. S. Quick on 1216. John Parmakian closure to 1216. G. R. Latham closure to 1285. George A. Whetstone, Stavros N. Nicolau on 1350.

1539. SED Research Report No. 14: A Survey of the Present Status of Refuse Engineering and Development. (SA) Results of the investigations of the professional status of refuse collection and disposal is stated, and data on new developments and improved practice is reviewed. Reference is made to a previous report (SED Research Report No. 11).

1540. SED Research Report No. 15: Possible Contributions by Sanitary Engineers to Air Pollution Research. (SA) The paper reviews lack of research in air pollution among sanitary engineers, in spite of special training. Main features include essential areas of investigation in both the laboratory and field.

1541. SED Special Report: Engineer's Joint Council Policy Statement on Air Pollution and its Control. (SA) This paper covers the development and need for an E.J.C. statement on air pollution, and certain principles of air pollution, general considerations, causes and methods of control.

1542. Water Quality in the Missouri River, by Glen J. Hopkins and Joe K. Neel. (SA) The paper examines the quality of water in the Missouri River from the standpoint of reservoir influences and pollutional influences. Factors considered are turbidity, hardness, alkalinity, and algae. Bibliography.

1543. The Effects of Air Pollution on Airport Visibility, by William T. Ingram and Louis C. McCabe. (SA) Air pollution seriously impairs visibility at New York City airports. Possible sources of pollution are given, and related meteorological conditions are described. It is brought out that until improvement in airport visibility is achieved, flights must depend on instrument flying during periods of critical visibility.

1544. Cement and Clay Grouting of Foundations: Present Status of Pressure Grouting

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Foundations, by A. Warren Simonds. (SM) Present-day uses of pressure groutings are described. Recent developments and improvements of drilling and grouting equipment, and also of grouting materials are mentioned. Examples of successful grouting are cited where core drilling has produced rock cores from foundations with cracks and seams well filled and bonded with cement grout.

1545. Cement and Clay Grouting of Foundations: Grouting with Clay-Cement Grouts, by Stanley J. Johnson. (SM) The uses of suspension grouts consisting of soil or soil and cement are reviewed, with a discussion of the design of grout mixtures.

1546. Cement and Clay Grouting of Foundations: The Use of Clay in Pressure Grouting, by Glebe A. Kravetz. (SM) This paper reviews properties, preparations, and testing of clay, clay-chemical, clay-cement, and clay-sand-cement grouts. Field techniques are cited.

1547. Cement and Clay Grouting of Foundations: The Use of Admixtures in Cement Grouts, by Alexander Klein and Milos Polivka. (SM) Aspects of the use of admixtures are presented with respect to grout mixtures. Types of admixtures, test equipment, and methods of testing are examined. Typical relationships among grout properties are illustrated.

1548. Cement and Clay Grouting of Foundations: Suggested Specifications for Pressure Grouting, by Judson P. Elston. (SM) In the field of foundation treatment, it is improbable that all problems arising during construction can be anticipated by the designer or specification writer. A workable and equitable specification can be resolved from previous experience and practices, geological data, design criteria, and the capabilities of the engineer confronted with a new foundation site.

1549. Cement and Clay Grouting of Foundations: Pressure Grouting with Packers, by Fred H. Lippold. (SM) The use of packers for controlling the injection of grout into a rock foundation is presented. A description of common types of packers currently being used is given, with comments on their adaptability to rock foundations. Advantages and disadvantages of the procedure are cited.

1550. Cement and Clay Grouting of Foundations: French Grouting Practice, by Armand Mayer. (SM) European experience has indicated that clay and clay cement grouts can be utilized to successfully control seepage through alluvial materials. Descriptions of foundation conditions, grouting programs and nature of the grout mix are given for four projects: Genissiat cofferdam, Fessenheim open pit, Ait Ouarda cofferdam, and Serre-Poncon dam.

1551. Cement and Clay Grouting of Foundations: Practice of the Corps of Engineers, by Edward B. Burwell. (SM) The cement grouting practice of the Corps of Engineers during the last decade has adhered closely to a well-established pattern of design and procedure. This paper outlines this practice, and the current grouting specifications requirements of the Corps.

1552. Cement and Clay Grouting of Foundations: Experience of TVA with Clay-Cement and Related Grouts, by George K. Leonard and Leland F. Grant. (SM) Most of the dams built by the TVA have required large amounts of grouting for foundation preparation. Clay-cement grout has been used where feasible, and it has been possible to obtain safe and watertight foundations at a much lower cost than by using usual neat-cement grout.

1553. Trajectory Bucket-Type Energy Dissipators, by E. A. Elevatorski. (PO) Factors in the design of trajectory bucket-type energy dissipators are given in this paper, with data from model and prototype tests. For all contemplated structures recourse to laboratory model studies should be made to refine or verify the merits of each design.

1554. Underground Power Houses in Italy and Other Countries, by Claudio Marcello. (PO) This paper presents the characteristics of a number of underground power houses mainly constructed in Italy on the writer's design or with his cooperation. The criteria aiding in the choice of the solutions adopted are given special attention.

1555. The Sudagai Underground Power Plant, Japan, by Tatsuo Mizukoshi. (PO) A description of the Sudagai project is presented, with attention given to costs and methods of excavation and concreting, model studies, and seismic forces.

1556. Montgomery Dam—Rock Fill with Asphaltic Concrete Deck, by F. W. Scheidenhelm, John B. Snetlage, and Arthur N. Vanderlip. (PO) This paper describes various aspects of design and construction of a rock-fill dam with an asphaltic concrete deck. The advantages and economy of this type of dam construction are cited.

1557. Discussion of Proceedings Paper 1078, 1115, 1178, 1224, 1274, 1336. (SA) No closure notice to 1078. Donald J. O'Connor and William E. Dobbins closure to 1115. John R. Snell closure to 1178. Marvin L. Granstrom closure to 1224. Tsung-Lien Chou on 1274. Leon E. Chase on 1336.

1558. Discussion of Proceedings Paper 882, 1038, 1162, 1166, 1167, 1197, 1202, 1260, 1262, 1266, 1331, 1332, 1345, 1395. (HY) No closure notice to 882. Hunter Rouse closure to 1038. A. M. Moore closure to 1162. David K. Todd closure to 1166. M. B. McPherson, H. S. Strausser, and J. C. Williams, Jr., closure to 1167. Vito A. Vanoni and Norman H. Brooks; E. Roy Tinney; M. L. Albertson, D. B. Simons, and E. V. Richardson on 1197. John F. Neville closure to 1202. Mushtaq Ahmad on 1260. Corrections to 1262. Gale B. Dougherty on 1266. T. Blench on 1331. M. B. McPherson on 1332. F. V. A. Engel on 1345. H. C. Riggs on 1395.

1559. Discussion of Proceedings Paper 1143, 1161, 1301, 1309, 1427, 1428. (SM) Elbert E. Esmiol closure to 1143. T. H. Wu closure to 1161. Yoshichika Nishida on 1301. Irving Sherman on 1309. Edward S. Barber on 1427. Edward S. Barber on 1428.

INSTRUCTIONS

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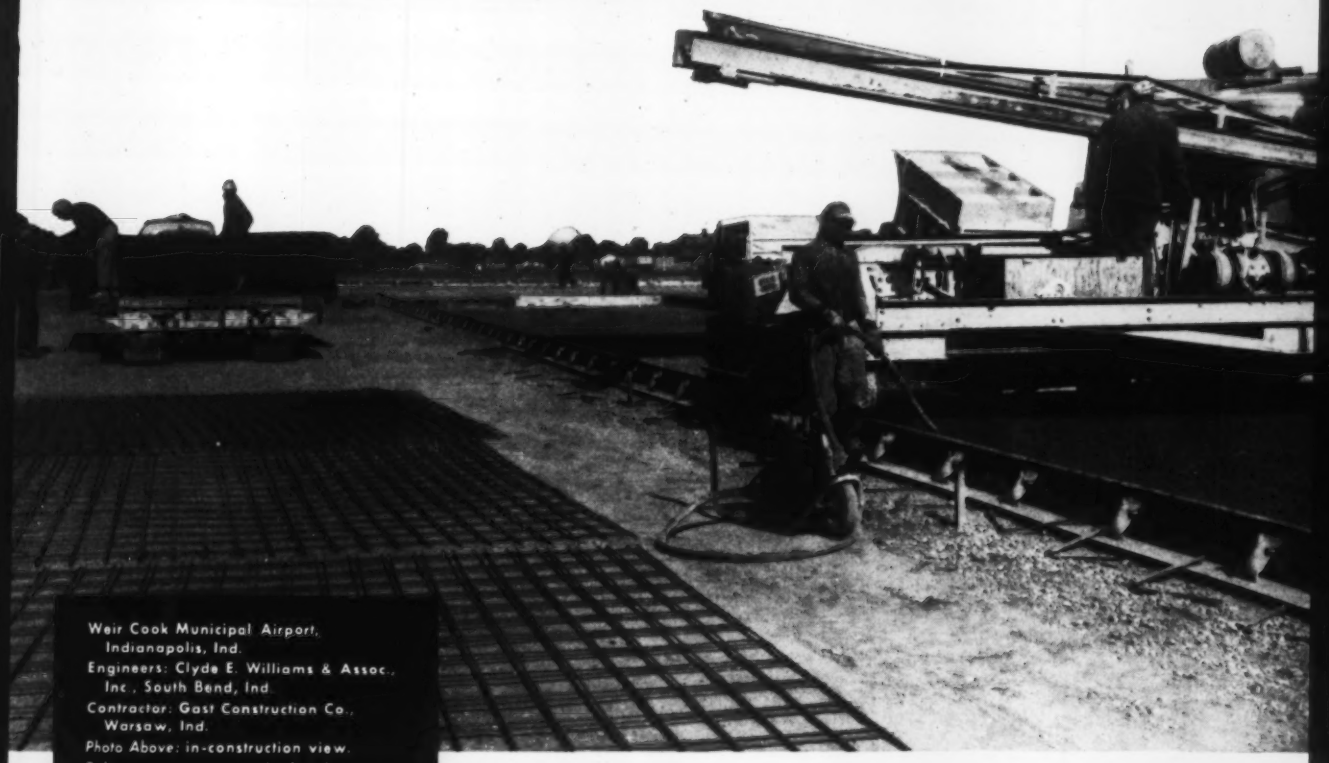
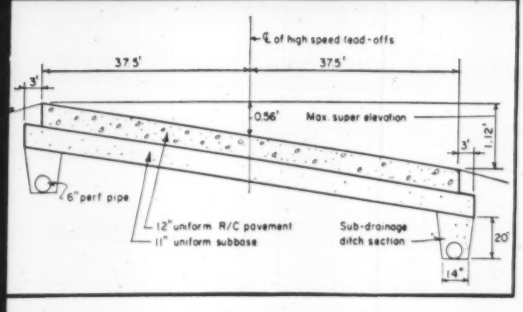
First High-Speed Runway Turn-Off



Weir Cook Municipal Airport, Indianapolis, Ind.
Engineers: Clyde E. Williams & Assoc., Inc., South Bend, Ind.
Contractor: Gast Construction Co., Warsaw, Ind.
Photo Above: in-construction view.
Below: new runway and related pavement.
Drawing: cross section through high-speed turn-off.



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3. ***Lower Cost-In-Place*** **concrete . . . because of savings in placing and finishing and because of higher strength resulting from low water content.**

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* **POZZOLITH—registered trademark of The Master Builders Company for its time-tested water-reducing, air-entraining admixture for concrete.**

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